Tappi

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NOVEMBER 1955

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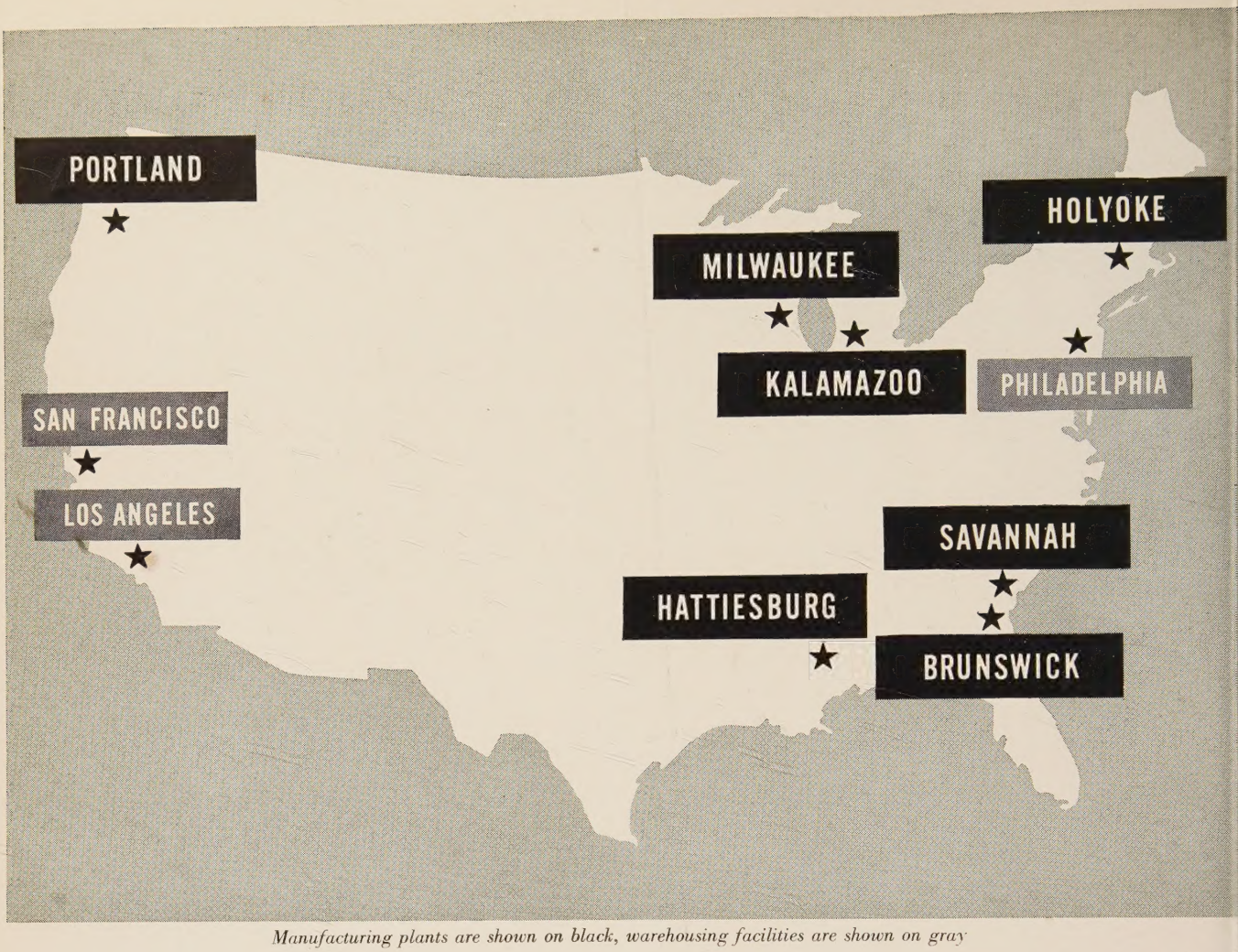

Manufacturing plants are shown on black, warehousing facilities are shown on gray

HERCULES SIZE ON YOUR DOORSTEP

Hercules' manufacturing and warehousing facilities for paper making chemicals are strategically located in all papermaking areas. This insures a dependable supply and prompt delivery service, two of many important reasons why paper mills use Pexol® as well as other Hercules papermaking chemicals. No matter where your plant is located, the nationwide distribution of Hercules manufacturing facilities places a stockpile of papermaking chemicals practically in your own back yard.

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HERCULES POWDER COMPANY

INCORPORATED

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PP55

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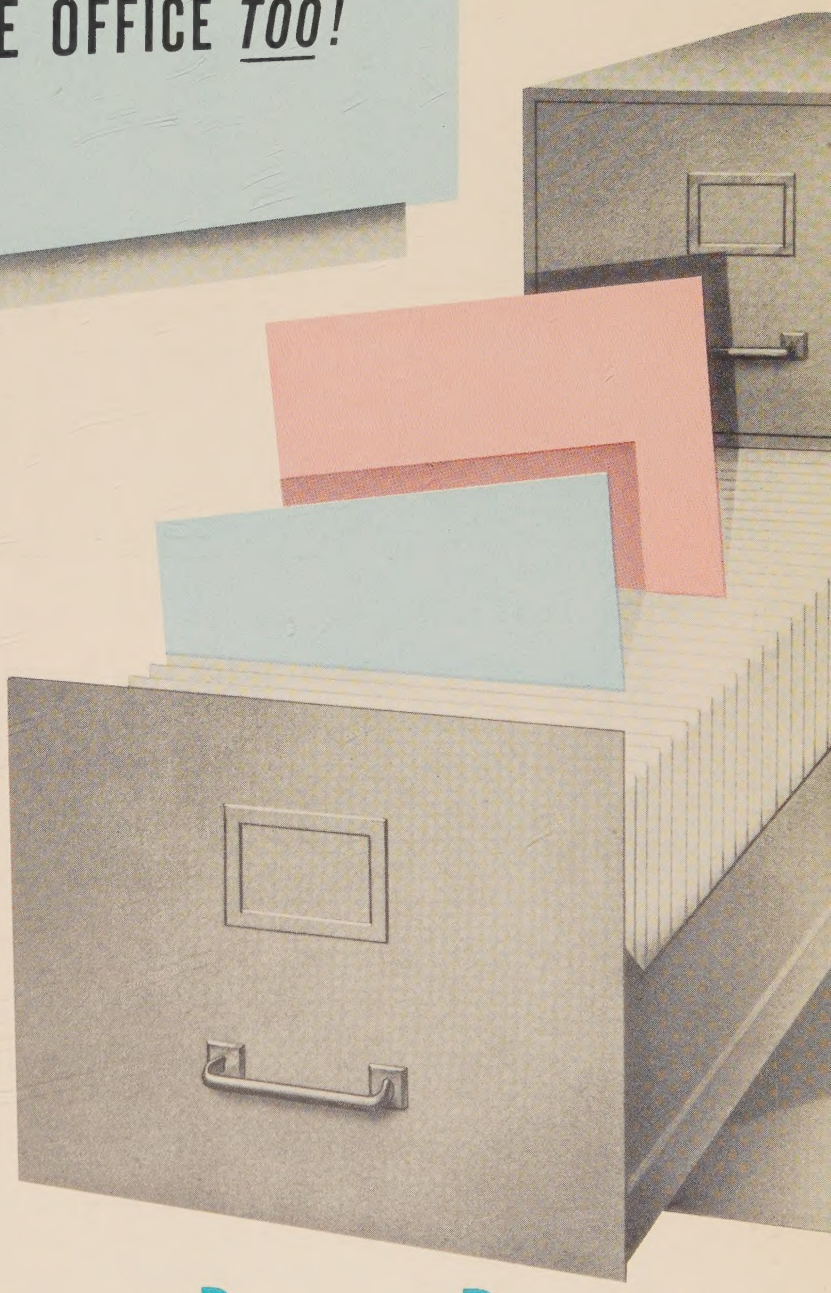

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TIME-SAVING

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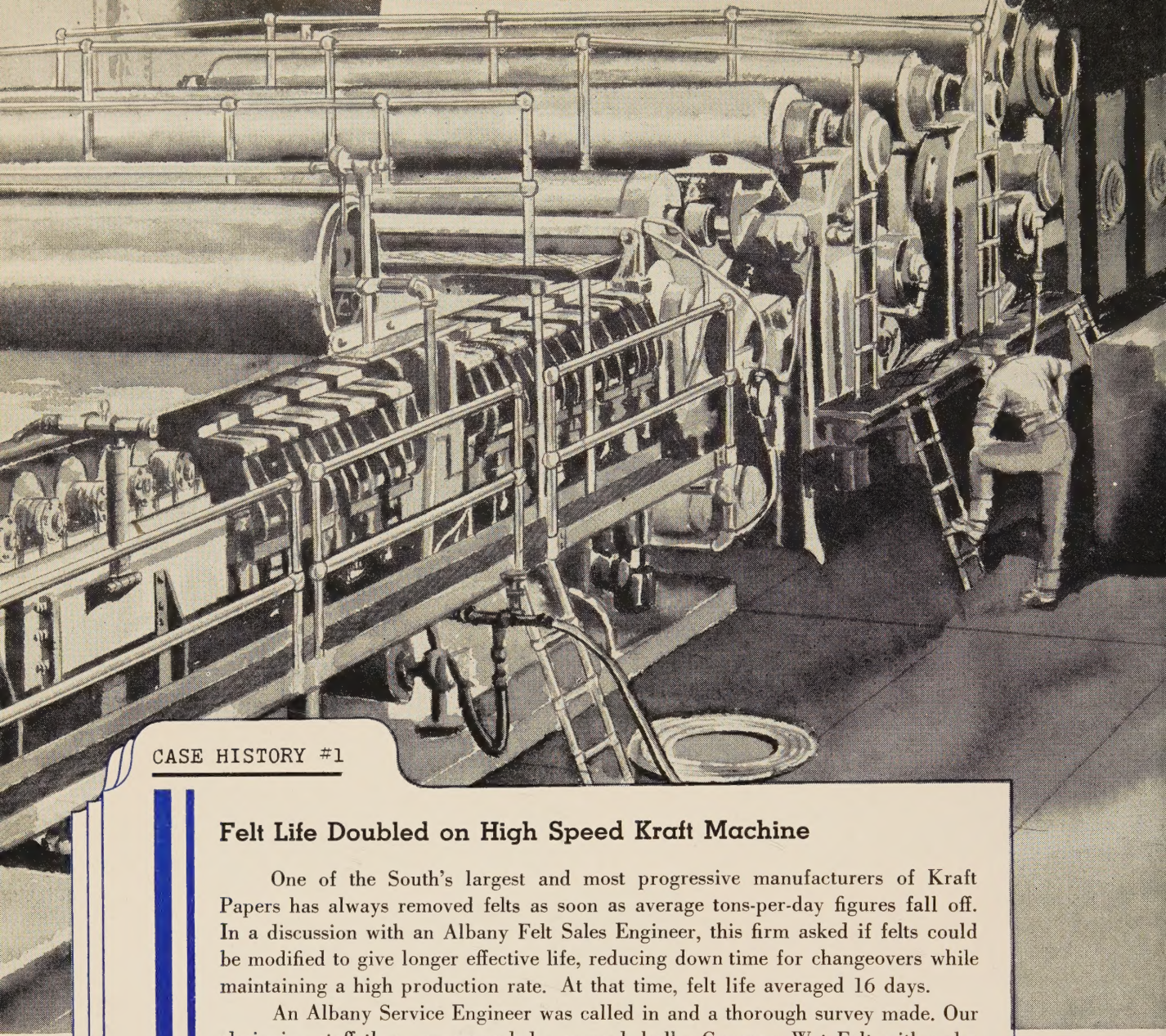

CASE HISTORY #1

Felt Life Doubled on High Speed Kraft Machine

One of the South's largest and most progressive manufacturers of Kraft Papers has always removed felts as soon as average tons-per-day figures fall off. In a discussion with an Albany Felt Sales Engineer, this firm asked if felts could be modified to give longer effective life, reducing down time for changeovers while maintaining a high production rate. At that time, felt life averaged 16 days.

An Albany Service Engineer was called in and a thorough survey made. Our designing staff then recommended a rugged, bulky Common Wet Felt with nylon content and chemical treatment, to be used interchangeably on first and second Press positions.

RESULTS: One year later, average felt life had increased to 19 days. With this new felt it was then possible to make further improvements in machine operating conditions. Today, figures show an average felt life of 32 days, with felt cost per ton cut to half the original figure and average production per day substantially increased.

For improved felt performance on your machines, call in your Albany Felt Sales Engineer. His analysis of your problems, together with the effor of the industry's top team of Service Engineers, Designers, Research and Laboratory Specialists, will bring you the felts you need to produce "m saleable tons per day!"

ALBANY FELT COMPANY

"THE WORLD'S LARGEST MANUFACTURER OF PAPER MACHINE FELTS"

MAIN OFFICE and PLANT, ALBANY 1, N. Y. Other plants: Hoosick Falls, N. Y., No. Monmouth, Me., Cowansville, Que

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1st in superbleaching

Seventy-five tons of chlorine dioxide a day for the superbleaching of paper pulp . . . that's the capacity of Mathieson chlorine dioxide units, projected and operating, in pulp mills today.

Twice the capacity of all other such equipment in use—the magnitude of this figure is indicative of the progress made by Mathieson in the field of superbleaching since pioneering the first commercial chlorine dioxide bleaching in a Wisconsin kraft mill over twenty years ago.

Mathieson's experience in superbleaching with chlorine dioxide is unmatched. It's this "know-how" that makes Mathieson the logical source for information and assistance when it comes to superbleaching problems. Next time you have questions about superbleaching or chlorine dioxide, feel free to call upon Mathieson's technical service staff for practical advice in the field . . . at no cost to you, of course. Contact our local representative or write today.

MATHIESON

MATHIESON CHEMICALS
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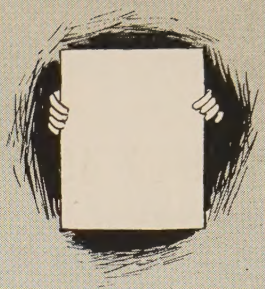
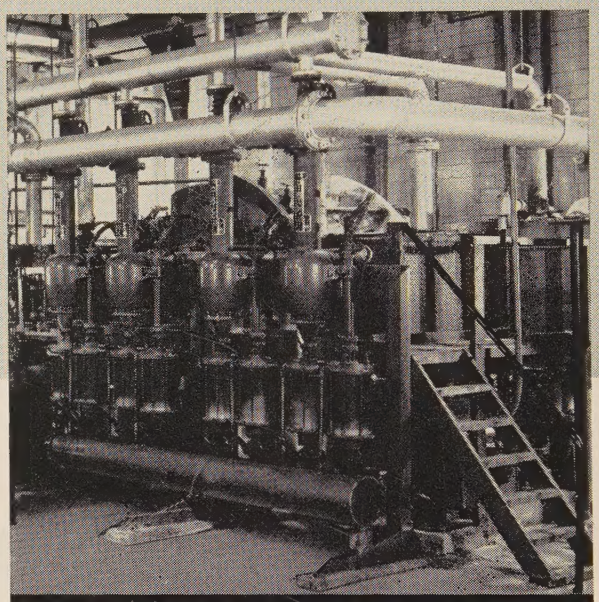
3342

NOT ONLY CLEANER PAPER



but MORE OF IT...

with DIRTECS ON THE JOB



These Dirtecs get all the abrasive bits and particles of fine dirt out of deinked stock that is made into bright, clean, high quality specialty papers and tissues.

Increased *quantity* of salable paper often goes hand in hand with increased *quality* when Dirtecs are on the job.

In one specialty mill, for example, Dirtecs are effectively removing abrasive bits of metal, grit or sand that formerly caused spots and holes in the finished paper. The ability of Dirtecs to get rid of these abrasive particles also results in fewer breaks, increased calender doctoring efficiency and less rejects plus a marked increase in the life of Jordan fillings, screen plates and machine wires. This mill credits Dirtecs not only with increased paper quality but with an actual 10% increase in the production of salable paper.

Dirtecs meet a wide range of dirt removal needs, handling big volumes of pulp or board stocks, all kinds and amounts of stock ahead of the paper machine or tailings from Bird Screens. They are available in regular or "king" size and may be equipped with continuous dirt evacuators when desired.

BIRD MACHINE COMPANY

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NOVEMBER 1955

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Brown Company's SOLKA SPECIAL DUR ALBA specification wood pulp prevents curl in your fine paper by means of inherent dimensional stability.

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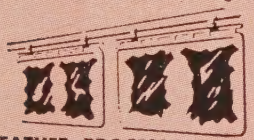
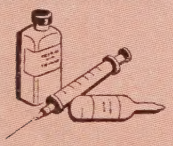
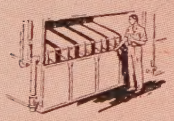


LEATHER PROCESSING
Two-bath chrome tanning



DRUGS AND COSMETICS
For bath salts, some disinfectants, parasiticides



TEXTILES
Assist in dyeing, printing; also used in making synthetic dyes.

MISCELLANEOUS USES
Bleaching groundwood, straw, fur. Organic chemical manufacture; water treatment.

Stocked for immediate shipment from distribution points throughout the U.S.A.

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General's Anhydrous "Hypo" is a sparkling, crystalline, water-free product that assays 98% $Na_2S_2O_3$. It is free from caking tendencies common to ordinary hydrated "Hypo"... dry feeds well ... dissolves rapidly in water to give clear colorless solutions free of troublesome impurities.

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West Virginia Pulp and Paper Company Pioneers New Waste Treatment Process

Dorr-Oliver Equipped Plant Sets Pattern For Industry

Covington, Va. Industrial waste treatment has taken a major step forward with the start-up of this new plant at West Virginia Pulp and Paper Company's Covington, Va., mill. A "first" for the alkaline pulping industry, it points the way toward a solution of these tough-to-handle wastes. Two years of pilot plant work went into the final design and the Covington mill's River Research Group worked closely with the National Council for Stream Improvement throughout all phases of the project. The firm of Weston, Eckenfelder and Hood was also called in to make an intensive round-the-clock analysis of pilot plant results.

The flowsheet as developed is unique. Basically it employs the activated sludge process, one of the standard methods for treating municipal sewage. A departure from standard practice is the addition of certain nutrients essential to the life of the bacteria which carry out the treatment process. Another is split treatment providing primary sedimentation for the portion of mill wastes containing solids and then parallel aeration and final sedimentation for the entire flow. A third is the use of complete instrumentation with one control panel governing the process and recording results.

Average treatment plant design is 16 MGD with a maximum capacity of 25 MGD. Major

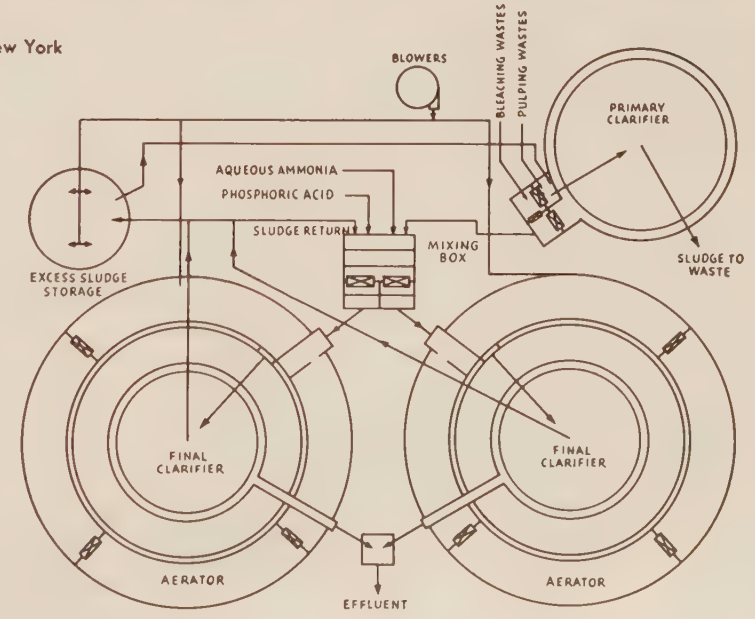
General view of the plant during final stages of construction. Dorr Primary Thickener is in foreground with Currie Claraetors in rear.

Consulting Engineers: GIBBS & HILL, INC., New York, New York

equipment units include a Dorr Primary Thickener and two Currie Claraetors.* These latter units employ Dorr Final Clarifiers surrounded by annular aeration channels. In this way two distinct phases are carried out in a single unit. When the plant reaches full operation an estimated BOD reduction of 80-90% will be made in the mill effluent being discharged to the Jackson River.

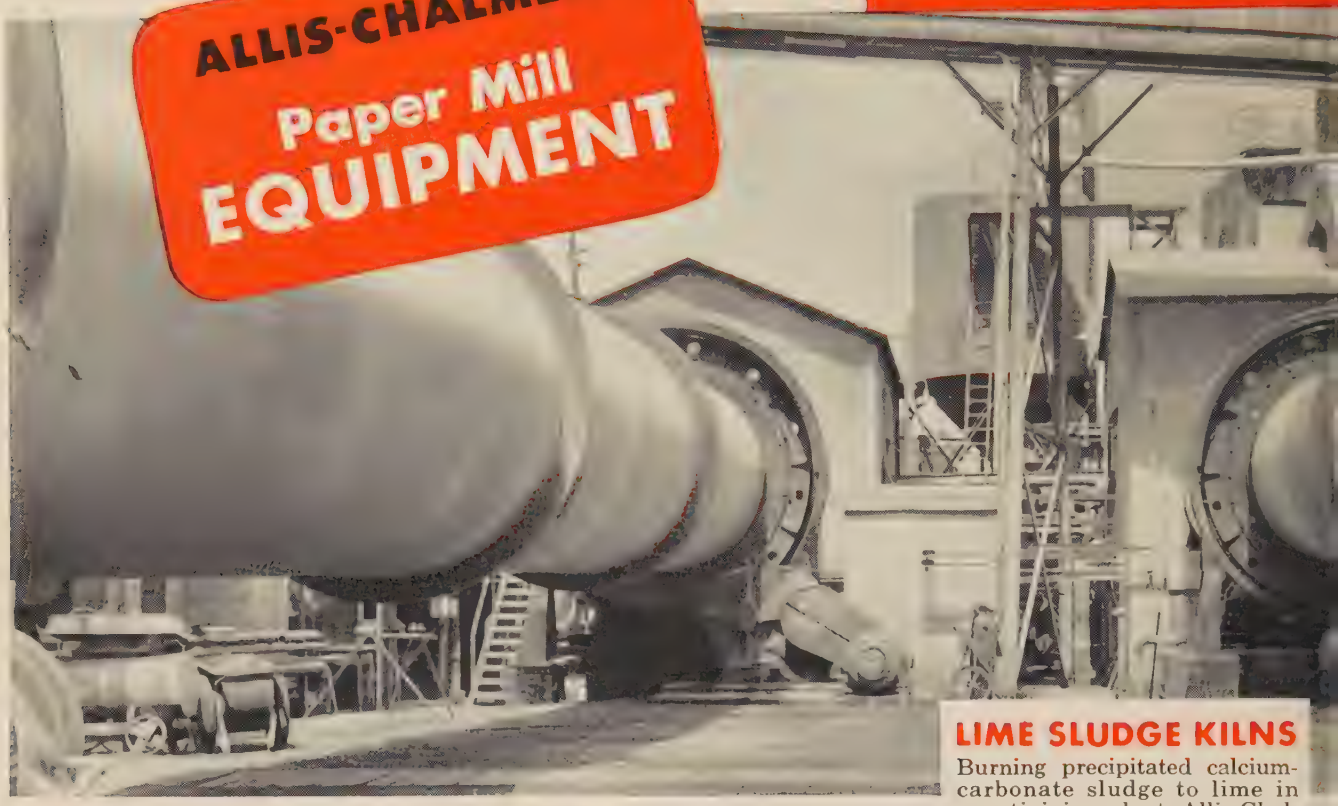
Dorr-Oliver Incorporated, Stamford, Conn.

*Trademark, Reg. U. S. Pat. Off.



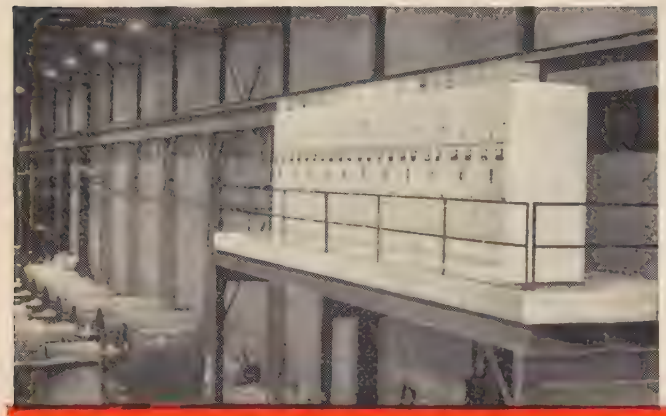
Specified for THIRD

ALLIS-CHALMERS
Paper Mill
EQUIPMENT



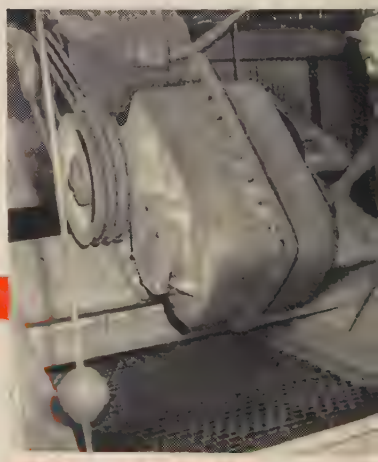
LIME SLUDGE KILNS

Burning precipitated calcium-carbonate sludge to lime in causticizing plant. Allis-Chalmers kilns offer fuel savings of as much as 40% with increased capacity, can reduce lime costs as much as 50%.



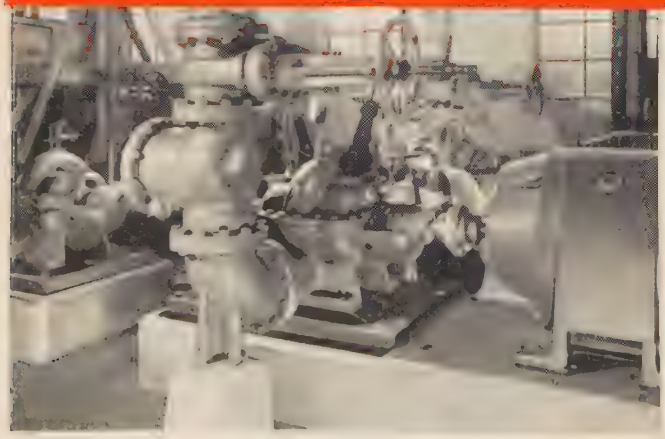
CONTROL

Factory-assembled Type HALS 2300-volt, 0.8 pf, three-phase, 60-cycle synchronous motor starter units installed on balcony above controlled motors. Motors are Allis-Chalmers synchronous types, six 400 rpm, 400 hp driving Jordan refiners; and two 450 rpm, 450 hp driving Sutherland refiners.



CHIP SCREENS

One of 8 Allis-Chalmers double-deck *Low-Head* chip screens in operation at Potlatch Forests. These units operate continuously, screening 16 units of chips per screen every hour.



PUMPS

The fresh water used at Potlatch is supplied by eight of these 12 by 10, Type SG pumps. Four are driven at 1765 rpm by 250-hp Allis-Chalmers motors, four at 1775 by 160-hp motors.

ALLIS-

EXPANSION Program

Potlatch Forests, Inc., Again Chooses Allis-Chalmers Equipment . . . for Dependable, Efficient Operation

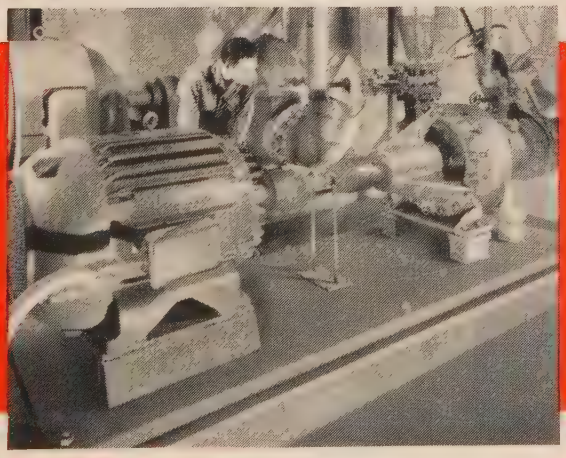
ALLIS-CHALMERS equipment, installed in their original plant, gave POTLATCH FORESTS, INC., of Lewiston, Idaho, the kind of service they needed.

When the time came for expansion of their facilities, Potlatch Forests called on Allis-Chalmers again.

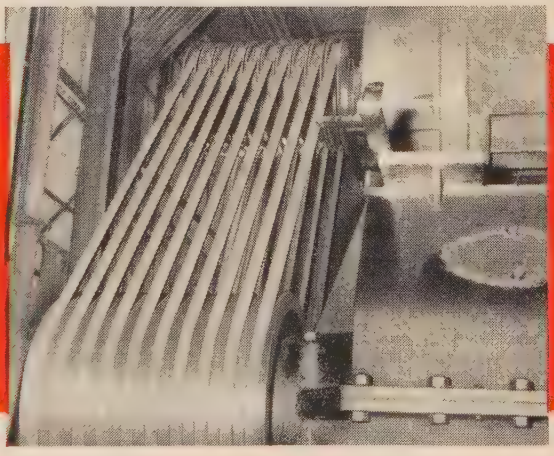
Allis-Chalmers engineers worked in close conjunction with the Potlatch planning staff to lay out the best possible plan for the required expansion.

Now finishing the third expansion program, Potlatch Forests reports that Allis-Chalmers equipment, operating in the expertly engineered flow, is paying off in maximum efficiency of machines and personnel.

For help with your paper mill equipment problems call your nearby Allis-Chalmers office or write Allis-Chalmers, Milwaukee 1, Wisconsin.



STOCK PUMPS
10 by 6, 750-gpm, 100-ft head, Type PWG pump moving unscreened bleach stock to flat screens. Driven at 1170 rpm by 60-hp induction motor.



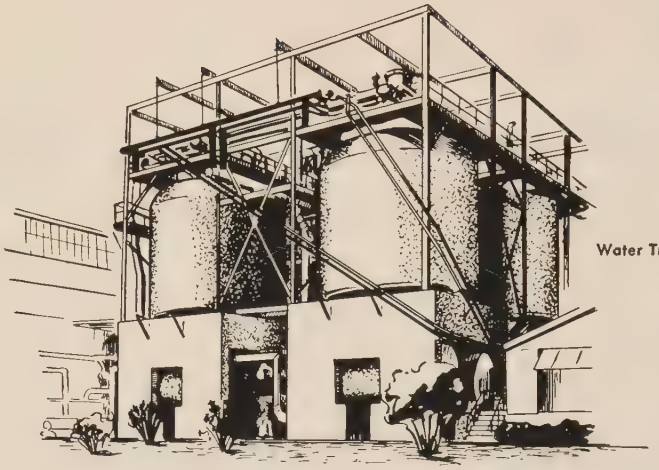
TEXROPE DRIVE
10-groove, D section *Texrope* drive with stationary control *Vari-Pitch* sheave running pulp press—powered by Allis-Chalmers 125-hp, 900-rpm motor.

A-C ALLIS CHALMERS

CHALMERS

Texrope, Low-Head and *Vari-Pitch* are Allis-Chalmers trademarks.

A-4819



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for Industrial Use

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Producing Units

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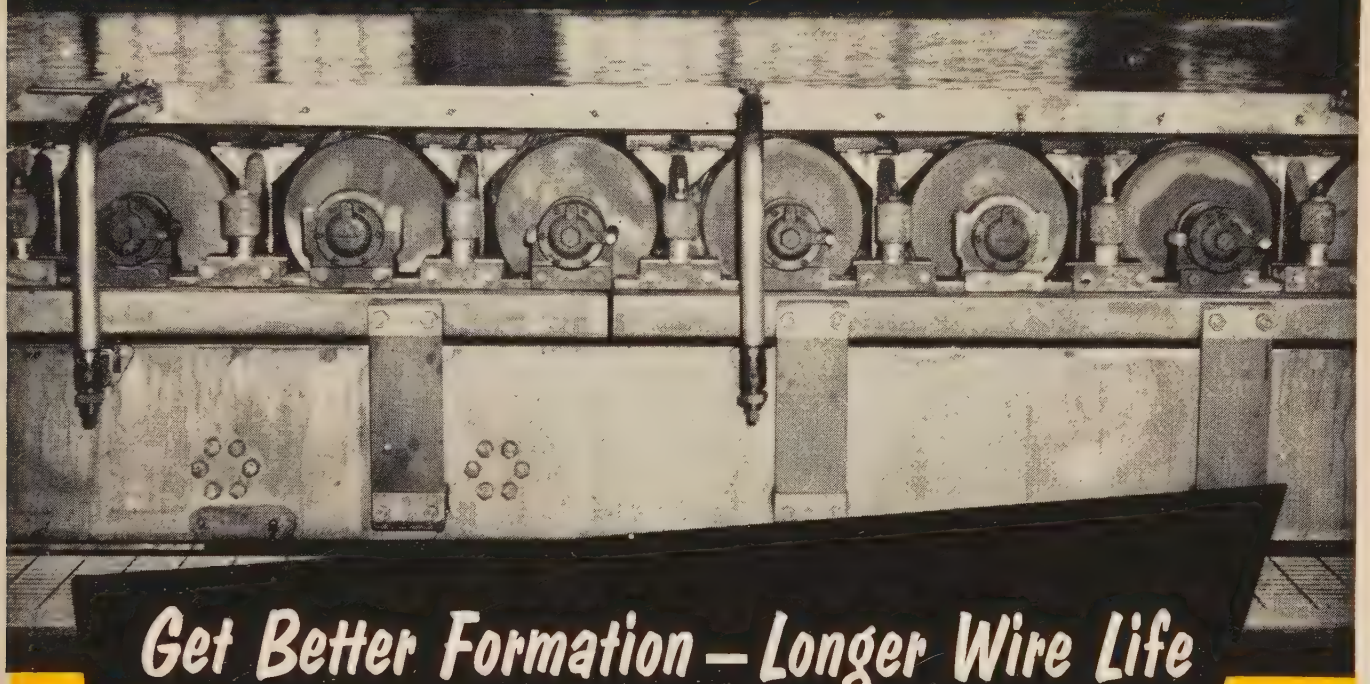
- **WORLAND, WYOMING**

Puseyjones "Y" Type Deflectors in use between the table rolls on high-speed 246-inch wide fourdrinier with 14½-inch table rolls.



Get Better Formation—Longer Wire Life

Puseyjones "Y" Type Deflectors go a long way toward improved formation and increased wire life — particularly at medium and high speeds. In addition, you get many other advantages when you replace your first six or more conventional deflectors with Puseyjones "Y" Type Deflectors. Here are a few of these bonus advantages:

- Slacker wires can be run . . . wire sag between rolls is eliminated
- The hump over the rolls is greatly reduced . . . the level wire table gives less disturbance during the early formation period
- Pinholes, cloudy formation and "worming" are at a minimum . . . less air and water are carried into the table roll nip

The Puseyjones "Y" Type Deflector is really a small "making" board. The leading blade supports the wire and prevents water-throwing against the trailing table roll. The trailing blade also supports the wire and helps to prevent "stock jump." The wire rides on a film of water, with virtually no wear on its underside. Blade material is Ryertex or Micarta, supported by a lightweight but rigid stainless steel frame; both vertical and horizontal adjustments are at each end.

If you have a deflector problem, let Puseyjones engineers help you solve it. Call the representative nearest you, or write us today.

THE PUSEY AND JONES CORPORATION
Established 1848 : : Builders of Paper-Making Machinery

Fabricators and Welders of all classes of Steel and Alloy Products

Wilmington 99, Delaware, U.S.A.

THE SIGN OF TRADE MARK SUPERIOR QUALITY

FORTY YEARS WITH TAPPI

R. G. MACDONALD and R. T. BINGHAM

THE FOUNDING OF THE TECHNICAL ASSOCIATION

IN PREPARING a history of an organization, such as the Technical Association of the Pulp and Paper Industry, it is necessary to consider a number of events and conditions leading up to its establishment.

In 1908 the U. S. House of Representatives made a thorough investigation of the wood pulp, print paper, etc. industries. Called to testify in these hearings were H. S. Bristol, chief of the Wood Chemistry Section of the Forest Products Laboratory, and Arthur D. Little, the official chemist of the American Paper and Pulp Association.

Mr. Bristol stated that he had charge of certain experiments to determine the value of various woods other than those then being used for paper pulp. Mr. Bristol said, in part: "Up to and including the early part of the year 1905 the Forest Service received considerable miscellaneous information concerning the growth of the pulp and paper industry in this country and the tremendous increase in the consumption of pulpwood due to the use of spruce, almost alone for this purpose. Many inquiries were received from people in various parts of the country, some even suggesting that the Forest Service undertake an investigation to determine if other woods could not be used and so relieve the strain on the supply of spruce. The pressure became so strong and the need of the study so evident that accordingly, the Forest Service established a small experimental laboratory in Boston for a preliminary investigation of the subject. The work at the start showed great possibilities especially when the statistics of 1905 came out and showed that the consumption of pulpwood in that year was about 3,192,000 cords, of which 71% was spruce, with an increase in the imports of pulpwood from Canada of 74.8% during the years 1899 and 1905. In this same period the increase in the consumption of wood other than spruce increased 275%. This was one of the points that made the Forest Service believe that the supply of spruce was rapidly diminishing. It was interesting to note that of the lumber cut for 1906 alone at least 15,000,000 cords of slabs and edgings, not including bark and sawdust, went to waste. This amount was about four times the total quantity of that used for pulp that year.

"The Forest Service is endeavoring to find a use for some of this material in the paper industry. Aside from the sawmill waste there is a good deal of waste in the form of unutilized species which in certain localities have little or no value. These include the eastern scrub pine, the white fir of the Pacific Coast, the Engelman spruce of the Rocky Mountains. They occur in large quantities and are cheaper than eastern spruce.

"The Forest Service does not claim that this idea of the utilization of various woods for pulp is new or original. We have heard of basswood and willow being used in the early history of the wood pulp industry. The majority of the experiments that have been tried have dealt with the soda process, and the sulphite process has been but little investigated. A few experiments have been tried with the sulphite process, but these have led to somewhat negative results, because of the excessive cost of using a commercial plant for experimental purposes. This is one reason why the paper trade up to this time has not done more work along this line. However, the results of the studies of the Section of Wood Chemistry of the Forest Products Laboratory have shown that a merchandisable pulp can be made from eleven different species by the sulphite process, seven of these are suitable for newspaper without bleaching, the others can be used in other grades of paper when they have been bleached, and in the unbleached state are valuable in the manufacture of wrapping paper, boxboards, etc."

In this same hearing the chairman stated "Reference has been made in the hearings to some investigations carried on by the American Paper and Pulp Association in regard to the use of other materials for paper."

Mr. Chabble, secretary of the A.P.P.A. responded: "The association has been employing for some years Arthur D. Little as its official chemist, and Mr. Little presented a report at our last annual meeting on Feb. 6, 1908 in which he refers to a number of plants which he suggests as excellent ones containing fibers for making paper."

Mr. Little's report stated in part:

"The most significant development of the year in papermaking has been the serious and general inquiry all over the world for new sources of paper stock. Wood is undoubtedly destined to maintain a position as one of the chief sources of supply for an indefinite number of years, and no possible substitute for groundwood is even in sight. There are, nevertheless, plenty of signs that we are on the eve of a readjustment in papermaking methods. To the growing scarcity of pulpwood, the continual rising price and longer haul with which papermakers using this wood are contending, will in a few years be added the competition of new and better stocks."

Mr. Little then pointed out the possibility of using flax, cotton, and other agricultural wastes. He also pointed out that there had appeared an unusually large number of books relating to papermaking during the year. These included Andes' "Treatment of Paper for Special Purposes." "The Papermill Chemist" by Stevens, Vols. III and IV of Beadle's "Chapters on

R. G. MACDONALD and R. T. BINGHAM, Technical Association of the Pulp and Paper Industry, New York, N. Y.

Tappi wishes to acknowledge the Assistance of the *Paper Trade Journal* for permission to reprint, in part, excerpts from the Twenty-fifth Anniversary Supplement of the *Paper Trade Journal*, Sept. 25, 1941.

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Papermaking," the third and enlarged edition of Herzberg's "Papier Prufing," "The Paper Trade" by A. Dykes Spicer, and "The Encyclopaedia of the Paper Industry" by J. S. Jensen appearing in the Danish journal, *Papier Tidende.*

The foregoing is cited to show the early state of pulp and papermaking technology. The technical approach was being handled for the industry largely by the Government and a private consultant's laboratory staff. The need to consider possible sources of raw materials evidently gave technically trained men their first opportunity to serve the industry. A review of the industry's magazines up to the time of the formation of the Technical Association shows that the allied industries were contributing most of the information to the literature in this country although in foreign countries the technical men had attained a foothold in a number of companies. From 1905 on the American industry began to utilize engineers and chemists.

In 1929 Henry F. Obermanns wrote to R. G. Macdonald, secretary of TAPPI, as follows:

"Previous to 1914 Ernst Mahler and the writer were members of the German Society of Paper and Sulphite Chemists. In June 1914 both of us attended the annual meeting of that organization. During this meeting, Mr. Mahler made a motion, which was seconded by me, that an American branch society along the same lines as the already existing Austrian and Scandinavian branch societies, be formed in America. The motion was looked upon favorably but the war, which broke out a few weeks later, of course put a stop to any development of this idea. As far as I was concerned, the idea was dormant. Mr. Mahler, however, apparently succeeded in interesting Arthur Hastings, who was at the time president of the American Paper and Pulp Association, who suggested a meeting of a few technical men to bring about a technical organization in the industry.

"Harry Fletcher of Alpena, Mich., took the leadership and brought about the first meeting of what later developed into the Technical Association of the Pulp and Paper Industry."

In the same year Harry Fletcher wrote to the secretary as follows:

"As I remember, it was back in February, 1914, that I went before the American Paper and Pulp Association and asked for permission to try and organize the engineers and chemists. Present at that meeting were Arthur Hastings, Frank Moore, Clarence Collins, Chick McDowell, Sam Upton, Doc Campbell, and some others.

"Following their approval, I sent out a questionnaire to all the mills to find out how many had men of this type. Following this, we wrote to certain mills and asked them to send representatives. This was where MacNaughton, Obermanns, Mahler, and myself came into the picture together. The first meeting was held in Chicago with Tommy Keenan and Professor McKee. If I remember correctly, we worked along at least a year in this manner until we received official recognition in February, 1915."

The First Meeting of the Technical Section of the A.P.P.A.

In considering the early history of the Technical Association it is of interest to refer to the original minutes of the first meetings that were held in Room 115 of the Waldorf-Astoria Hotel (5th Ave. at 34th St., New York, N. Y.). H. H. Bishop, secretary of the Wrapping Paper Division and acting secretary of the American Paper and Pulp Association, presided.

Before proceeding with the minutes it is of interest to note the comments made in the address of the President of the A.P.P.A., Frank L. Moore, of Watertown, N. Y., at the annual meeting held on Feb. 18, 1915:

"I am glad to see the interest that is shown in the establishment of a technical division in connection with our association work. An exchange of ideas among practical mill operators through this division should be invaluable. There has been no attempt made in providing the parent organization with funds to take care of this division, so it is left to those who are interested in this, if they wish to meet, to provide the means of handling it by those who are willing to join it, and the information and result of its meetings will be confined to this division and those who contribute to its support."

And from the annual report of the acting secretary, H. H. Bishop:

"On Sept. 29, 1914 we presented to the members a plan suggested by one of them to form a new division to be called the Technical Section and whose province would be to gather and disseminate information concerning matters that had to do with actual production. We asked them to express an opinion as to its desirability. To this communication addressed to 250 companies, 68 replies were received, 54 of which were favorable, 7 not interested, and 7 undecided.

"As a result of this endorsement of the plan a meeting to form such a division has been scheduled for tomorrow, the 19th, at 10 a.m. in room 115 of this hotel."

Following are excerpts from the first meeting of the Technical Section of the American Paper and Pulp Association, the forerunner of the Technical Association:

H. H. Bishop: Gentlemen, this is a meeting called for the purpose of discussing the advisability of forming a division of the American Paper and Pulp Association, to be known as the Technical Section, or by such other name as you may in your wisdom think best. The call was sent out at the suggestion of Harry E. Fletcher of the Fletcher Paper Co., Alpena, Mich., who, in conversation with me on the occasion of the meeting of the Wrapping Paper Division in Chicago, suggested that the existence of something of this kind would be a good thing since it would give to the producing end of the industry the same advantages that are felt to accrue to the executive and sales ends.

It impressed me and it impressed your president, Mr. Moore, as being an excellent suggestion, one for which we were very grateful and we have taken pains to investigate to see if there was any interest in it, and have been surprised to find how many people felt that such a division was a most desirable thing.

I would suggest that you select someone from your own group to preside on this occasion, and I will take a seat in the back where I can learn something that I do not now know. I will entertain a motion for someone to act as chairman.

Henry W. Stokes: I will nominate Harry Fletcher as chairman of this meeting.

Robert A. D. Ault: I second the motion.

The motion was carried and Harry Fletcher took the chair.

Chairman: Gentlemen, in talking this matter over this

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morning with a few people we thought that it would be a good idea to get some medium of exchange for technical ideas. No matter what branch of the industry we may be in we use about the same kinds of processes and machinery.

If we would combine to study papermaking machine design and operation we should be able to uncover a number of ideas that would not only be of value to us as papermakers, but to the manufacturers of papermill machinery, as well. There are many subjects to be considered such as felts, wires, wood, mill chemistry, sizing power, operations, etc.

We had a very nice meeting here 2 years ago last December. There were about 30 in attendance to discuss costs. The results were good and later we had a meeting in Chicago which seemed to wake us up to the possibilities of an organization such as this.

Now we had better give some consideration to the manner of organizing. Because of our varied interests we had better consider the advisability of dividing into special sections so that those interested in specific subjects can get together for discussion. We might proceed to collect data through our official chemist and use a publication such as *Paper* or some other trade magazine to publish our reports. Before going ahead I believe that this would be a good time to hear from our official chemist, R. H. McKee, of the University of Maine, who has his official report to the American Paper and Pulp Association ready for presentation.

Professor McKee read his prepared report in which he stressed the need of studying other fibers than those in common use, to meet future requirements for pulp and papermaking. He recommended that studies be made of tamarack, jack pine, Douglas-fir, and other wood as well as agricultural waste products such as flax straw, sisal, cotton seed hulls, bamboo, and hemp. He dealt with the stream pollution problem, sulphite spent liquor, dyes, new pulping processes, and bleaching.

R. H. McKee: In asking me to speak before the Technical Section, Mr. Bishop asked me to make suggestions as to what might be accomplished by such a group. Before touching this question, allow me to offer my congratulations to the men who are gathered here. This meeting and the organization of this section, promise to do more toward putting this industry on a sound and paying basis than any previous step taken by the American paper and pulp industry.

It is, moreover, a pleasure to acknowledge that the advance nearest in importance to this, that of interesting American mills to put in cost systems was largely aided by the initiative of the same H. E. Fletcher who suggested to President Moore the formation of this Technical Section of the American Paper and Pulp Association.

It has often been said "that there is active and substantial cooperation in every interest which in any manner touches the production and consumption of paper, except by the manufacturers themselves." The formation of this section promises more toward a change from the condition given in the quotation, if it is a true statement, than any other step that could taken. Men engaged in the production and scientific phases of mill work have much to gain, at no injury to the mills they represent, by attendance at and discussion in such meetings.

Some subjects which I believe should be taken up at an early date are the following:

1. The paper manufacturer needs to be able to tell from a sample of a pound or less of pulp what kind of paper it will make, or whether in a given furnish, it will serve to give the desired properties to the paper.

2. Standard definitions for the different grades of bleached and unbleached pulp are needed. Perhaps with this should go a definition for overbleaching, since the evil effects of overbleaching of pulp are but rarely fully appreciated by the pulpmaker.

3. It is possible that a different unit might be used in the purchasing of pulpwood to the mutual advantage of the buyer and seller. Certainly the mill should buy the wood on the basis of pulp produced and the 128-cu. ft. cord does not measure that accurately. The cellulose content varies much with the quality of the wood, especially if calculated on the yield per volume of 128 cu. ft. e.g., sound spruce and balsam fir vary in yield from 16 to 24%. Twenty-five years ago, wood 8 to 18 in. in diameter cost $3.00 per cord at the mill; now, the actual content of the cord is different, in that often one-half of the wood will not be over 3 in. in diameter. Then, there was no need for accurate measurement of the wood, but today wood is expensive and accuracy is needed.

4. A discussion of the manufacture and use of by-products. The mill dividends appear to be largely linked in the future with the use made of by-products.

5. Textbooks, testing methods, and bibliographies on special subjects of interest to men working in the industry are needed.

Chairman: You have heard the reading of this report. What is your pleasure?

Mr. Stokes: I would suggest that the secretary be requested to enter the report in the records of the Association and further that the attention of the members generally, by letter or otherwise, be called to the fact that this section is started and that they have access to the report made by Professor McKee.

The motion was seconded by W. L. Davis, Jr., and carried.

Chairman: I think that we should now take up some ideas in regard to the organization of this section. One thought that I had was to get representatives from such divisions as writing, book, wrapping, tissue, cover, specialties, board, and pulp and arrange to get together to make further plans. We will not get far in the first year, but we will get better acquainted. We might plan to hold regional meetings at such places as New York, Buffalo, and Chicago. We would like to have the advice of Mr. Stokes.

Henry W. Stokes: There is but little that can be accomplished here. I believe that your idea of appointing a committee to study this matter is a good one. You should have as broad a representation as possible both from the standpoint of kinds of paper and papermaking regions.

Chairman: Thank you. If there are no objections I will discuss the plan of organization with Mr. Moore and will take into consideration the many suggestions that have been received from paper companies. I will then appoint and meet with a small committee to make definite arrangements for the future and get the organization started as soon as possible.

I would like to have Mr. Bishop let us know who are present at this meeting.

Mr. Bishop read the attendance list as follows:

Robert A. G. Ault, Schmidt and Ault Paper Co.
W. W. Goodnow, Asst. Treasurer, Fort Orange Paper Co.
W. L. Davis, Jr., Asst. Superintendent, Dells Paper & Pulp Co.
W. H. Savery, President, Shenandoah Pulp Co.
C. C. Emigh, Superintendent, York Haven Paper Co.
W. H. Brownell, York Haven Paper Co.
H. P. Carruth, Chief Chemist, American Writing Paper Co.
Edward E. Lewis, Specialist in Steam Saving Devices
D. L. Bellinger, Engineer, Finch, Pruyn & Co.
W. O. Johnson, Superintendent, Strathmore Paper Co.
G. S. Veeder, Vice-President, Pioneer Paper Co.
J. Arthur Hayes, General Manager, M. & W. H. Nixon Paper Co.
C. I. McNair, Vice-President, Northwest Paper Co.
N. K. McNair, Superintendent, Northwest Paper Co.
Henry W. Stokes, President, York Haven Paper Co.
J. J. Frank, Asst. Manager, Ancram Paper Mills
Harry E. Fletcher, Fletcher Paper Co.
Gerould T. Lane, Asst. Superintendent, B. D. Rising Paper Co.
Roy Campbell, Secretary, Canadian Pulp and Paper Association
Theodore W. Dunn, Vice-President and Superintendent, Detroit Sulphite Pulp & Paper Co.
Arthur V. Farr, Engineer, SKF Ball Bearing Co.
F. Lockwood, Engineer, SKF Ball Bearing Co.
M. W. Waldorf, Waldorf Box Board Co.

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H. Newton, Newtown Paper Co.
B. Benson, Bulkley, Dunton & Co.
L. M. Alexander, Nekoosa-Edwards Paper Co.
George W. Bayless, Bayless Manufacturing Corp.

CHAIRMAN: I would now like to have an open discussion for the benefit of our organizing committee.

MR. CARRUTH: There are two different aspects which a technical association of this kind should consider. The first is the mechanical side which appears to have greater prominence in today's program. The other is the chemical side. Many subjects will interest both engineers and chemists in the paper mills, but there will be subjects of prime interest to one or the other and I believe that should receive special consideration in the organization plan.

I am personally interested in the chemical side and I know that there are a great many things that an organization of this kind can do that will be of great service. The committee should consult with both engineers and chemists in working out their plan.

CHAIRMAN: That is a good suggestion, Mr. Carruth. In addition to kind of products and regional distribution we will need to consider the needs of the various types of our members --managers, engineers, chemists, and superintendents.

MR. CARRUTH: Is it not true, Mr. Chairman, that the engineering and chemical problems are about alike irrespective of the kind of product that a mill is making?

CHAIRMAN: That is about right, but I believe that we need to consider our regional distribution of mills and arrange to have meetings in such places as Holyoke and Kalamazoo so that we can encourage the attendance of a great many superintendents who could not afford the time to travel a considerable distance to attend a meeting. Many of the smaller mills could afford to send their men to meetings only when they are held nearby.

MR. STEWART: Mr. Chairman, I appear for Clarence I. McNair who had to go to a newsprint meeting and asked me to say to you gentlemen that there had been nothing done by the American Paper and Pulp Association in which he was so much interested as in the formation of this Technical Section. The problems that will be solved by it for his company will be of the greatest economic worth to him. For him, I want to say that you can count on having his earnest advice and any help he can possibly give you.

CHAIRMAN: Please thank Mr. McNair for us. We now have a motion authorizing your chairman to appoint an organizing committee of five.

The motion was seconded and carried.

CHAIRMAN: We will get the committee together and get a report back to you as soon as possible. Mr. Farr of the SKF Ball Bearings Co. of Philadelphia is here today to give us a lecture on the application of ball bearings to papermaking machinery. We would be glad to hear from Mr. Farr at this time.

Arthur W. Farr proceeded with his lecture covering the application of ball bearings to barkers, jordans, fourdriniers, cylinder machines, drier rolls, transmission parts, and auxiliary equipment.

Mr. Farr said, in part—"Although a great deal has been done in the last 3 years in applying ball bearings to papermaking machinery, it must be frankly confessed that we are still on the borderland. The applications of ball bearings now in everyday use, however, have convinced manufacturers that the possibilities are enormous and the advantages greater than had first been estimated.

"A decade ago, the use of ball bearings on papermaking machinery was an inventor's dream. Today (1915) ball bearings are a tried and proved reality, already a part of the standard equipment of a number of the larger paper machine manufacturers."

CHAIRMAN: I think we all want to thank Mr. Farr for his most interesting lecture. I believe that this is just one of many subjects that will receive the attention of this section. He has pointed out the cooperation needed and received from paper mills by machinery manufacturers. This cooperation is obtainable and through this section the results obtained will undoubtedly be made available to our members. By thorough discussions at our meetings the industry will be informed on results and can spend its money more effectively and economically by buying equipment that will do the best job at the least cost and will not have to invest in "lemons" as many have done in the past.

We have another talk today by Mr. Ripley, a consulting engineer, on "Heat, Light, and Power in Paper Mills."

MR. RIPLEY: "Gentlemen, in 1914 you spent between 20 and 23 million dollars for heat, light, and power. This indicates the magnitude of the engineering phase of your industry and the opportunities that this technical organization has to study ways and means to assure your industry of the optimum uses of this power. For example, a Pennsylvania mill makes a ton of wrapping paper at a total engineering cost of $2.39 while a wrapping paper mill from Connecticut spends $10.46 to make a ton.

"The survey which you helped me prepare shows that one New York tissue mill spends $3.84 per ton and another New York tissue mill spends $14.20. A New York board mill is paying $2.39 and a West Virginia mill is paying $4.94. A Wisconsin pulp mill spends $2.15 and a New York pulp mill $5.30. There is room for considerable study on your part to get these figures closer together."

D. D. Kimball, speaking before the A.S.H.V.E. made this comment: "I have heard this claim made many times, and I have come to the conclusion myself, that the steam leaving a boiler might go through an engine and into the heating system without losing any of its efficiency insofar as the heating system is concerned."

Mr. Ripley discussed the relative merits of purchased vs. manufactured power, etc.

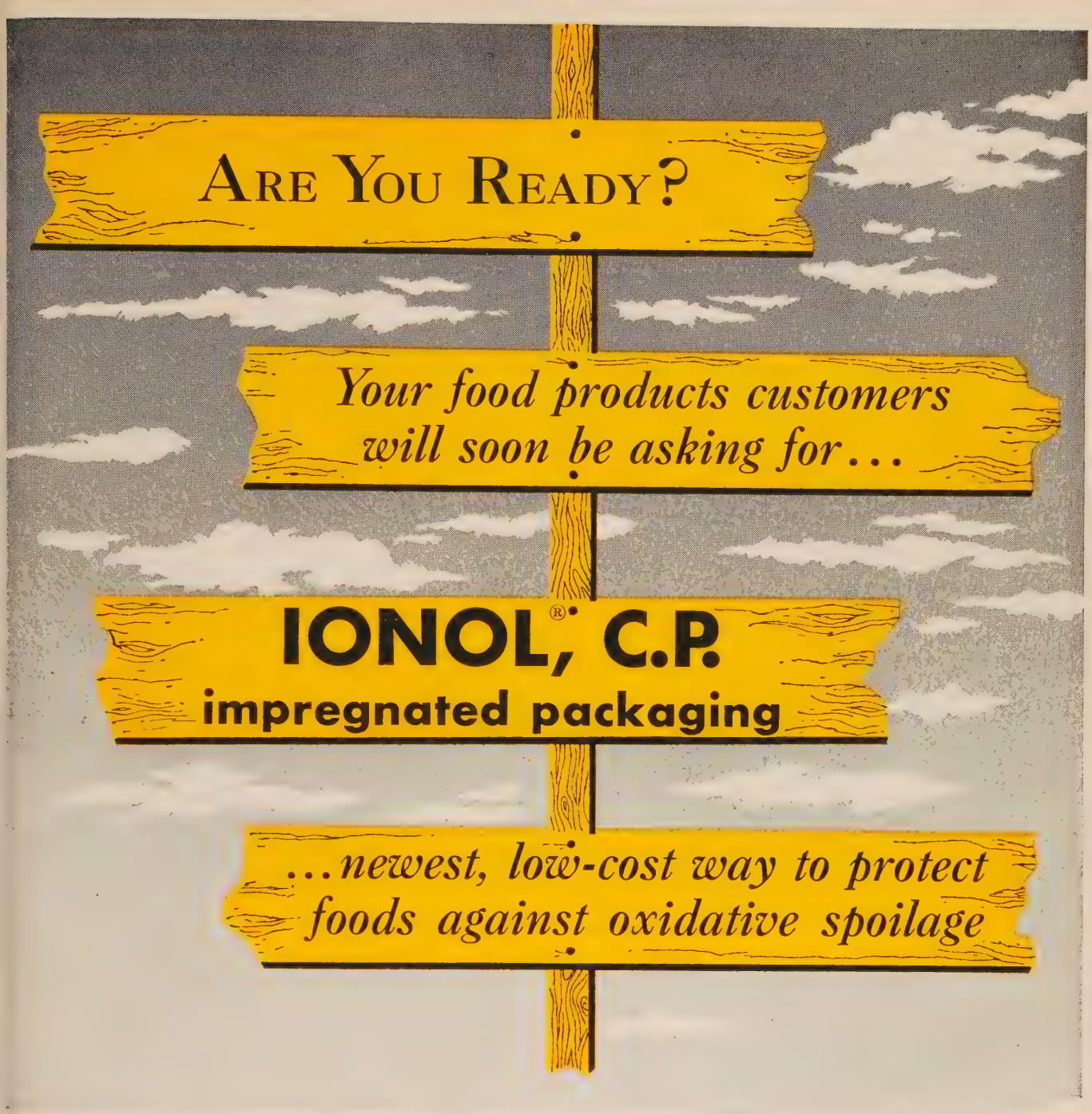
CHAIRMAN: Thank you, Mr. Ripley, for all this information. Are there any further comments? If not we will adjourn this meeting and proceed to get ready for the next one to be held in the fall.

Meetings of the Technical Section Organizing Committee

Following the meeting of Feb. 19, 1915, which was attended by about 35 and at which a temporary organization was formed for the purpose of launching the new section, there were two meetings of the committee of five appointed by the chairman.

As first named this committee consisted of the chairman, Harry E. Fletcher of the Fletcher Paper Co., Alpena, Mich., W. G. MacNaughton, Nekoosa-Edwards Paper Co., Port Edwards, Wis., Charles F. Rhodes, International Paper Co., Glens Falls, N. Y., Henry F. Obermanns, Hammermill Paper Co., Erie, Pa., Ernst Mahler, Kimberly-Clark Corp., Neenah, Wis., and Ralph H. McKee, University of Maine, Orono Me. The latter was a member of the committee by virtue of being the official chemist of the Association. The office was abolished at this time and his membership on the committee terminated.

The committee met for the first time on April 6, 1915 in Chicago under the chairmanship of Mr. Fletcher, Mr. MacNaughton acting as secretary, when a constitution was tentatively adopted, and a subcommittee was appointed to confer with the editor of *Paper* regarding the publication of the proceedings. A committee was also named to consider the question of offering prizes for competitive essays and to submit a list of subjects.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In the meantime circular letters had been sent out to the owners of pulp and paper mills throughout the country, accompanied by blanks calling for information regarding the men in charge of technical work, such as details of experience, educational training, positions held, both past and present, etc., and the replies were tabulated and indexed for the use of the secretary who was yet to be appointed.

A second meeting of the committee was held in Chicago on May 6, 1915, with the president of the American Paper and Pulp Association (Frank L. Moore of Watertown, N. Y.) in the chair. After making some minor changes in the constitution and adopting the title of Technical Section of the American Paper and Pulp Association as the name of the organization, Harry E. Fletcher was elected chairman of the Executive Committee with W. G. MacNaughton and Ernst Mahler as associates.

Thomas J. Keenan, editor of *Paper,* was chosen secretary-treasurer, and *Paper* was designated as the official journal of the section. As a Committee on Publications, Charles F. Rhodes and Henry F. Obermanns were named. The annual dues of members and associate members was placed at $5.00, each member to be entitled to receive *Paper* as part of the privileges of membership. The following is a summary of the constitution as finally adopted:

Constitution of the Technical Section

The Technical Section of the American Paper and Pulp Association is an organization of individuals apart from the activities of the parent organization.

Article I. Name: This association shall be called the "Technical Section of the American Paper and Pulp Association."

Article II. Objects: The objects of the Section shall be: (1) to stimulate interest in the science of pulp and papermaking; (2) to provide means for the interchange of ideas among its members; (3) to encourage original investigation.

Article III. Membership: There shall be two classes of members: (1) Members; (2) Associate Members.

1. Qualifications for Members: Any person who occupies a position with a member of the American Paper and Pulp Association, who has had a satisfactory technical education, or who, though not having had a technical education, has special qualifications and experience.

2. Qualifications for Associate Members: Any person who will assist and support the aims of the Technical Section of the American Paper and Pulp Association, and who, by virtue of his qualifications, is likely to further the work of the Section.

Associate members have all of the privileges of the Technical Section except voting and holding office.

3. Applications: All applications for membership must be made to the Secretary in writing and shall embody a concise statement with dates of the candidate's technical training and experience, and shall be in a form and in such detail as may be prescribed by the Executive Committee.

4. Election of Members: Each candidate for membership shall be proposed and seconded by members of the Technical Section and shall be voted on by the Executive Committee of the Section, a majority of whose votes shall be necessary for election.

The Executive Committee shall also decide as to which class of membership the candidate is entitled.

5. Honorary Members: Honorary members may be elected at any time by unanimous vote of the Executive Committee. They shall have all the privileges of members but without payment of dues.

6. Dues: The annual dues for members and associate members shall be $5.00 payable at the beginning of the calendar year. A member who has not paid his dues at the end of the year shall be suspended.

It was originally proposed to hold the next regular meeting of the section at Kalamazoo, Mich., early in June, but it was decided at the Chicago meeting to defer this until later in the year, the secretary being instructed meanwhile to get into communication with the mills at that place in order to perfect arrangements.

Writing editorily in *Paper* at this time, Thomas J. Keenan stated: "There is every indication that the Technical Section of the American Paper and Pulp Association will ultimately prove a factor of great importance in the industry. It has long been felt that insufficient attention has been paid to the training of men for technical positions in pulp and paper mills and this is a defect to be remedied. Mill chemists and engineers will be encouraged to communicate the results of their investigations when this can be done without detriment to the manufacturers concerned, and it is hoped by this means to make the regular meetings especially interesting and valuable to all participants."

Second Meeting at the Grand Central Palace

The second regular meeting of the Technical Section was held at the Grand Central Palace in New York City during the National Exposition of the Chemical Industries on Sept. 23, 1915.

In reporting the meeting the *Paper Trade Journal* commented as follows:

"The atmosphere created by the National Exposition of Chemical Industries at the Grand Central Palace during the past week was fitting and inspiring and peculiarly well adapted to assure a successful meeting of the Technical Section of the American Paper and Pulp Association. And the meeting of the latter, which was held on September 23, can be considered in more ways than one, as having been a meritorious and propitious event in the current epoch of papermaking. Perhaps the most valuable benefit resulting from the session is the fact that the need of a body of this kind was realized to a degree surpassing that which has ever yet been conceived.

"The realization of the splendid achievements which might be accomplished by bringing together into one organization the technical brains in the industry represented by this section, was represented by the papers that were read and the ideas that were suggested for the general welfare of all those concerned.

"Cooperation and standardization—cooperation in solving the various problems on which its members were laboring, and standardization of chemical tests and mill control—these are two of the needs which have long been sought in the trade, and these are the two functions which the new section purposes to initiate and perfect as soon as possible.

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"There was no lack of enthusiasm throughout the meeting. The attendance was large and representative and the discussions that followed the reading of the various papers was animated and interesting."

The chairman, Harry E. Fletcher, opened the meeting and introduced Frank L. Moore, president of the American Paper and Pulp Association who analyzed the conditions surrounding the paper trade, and dwelt on the unlimited possibilities which were open to the Technical Section. Mr. Moore said, in part:

"This section of the American Paper and Pulp Association was started at the last annual meeting held in this city in February. At that time there was a committee appointed to prepare preliminary plans and methods under which it might be organized, and your president was given the power to appoint a permanent committee. The committee that was selected at that time was such an excellent one that I made it permanent. This was a good choice, judging from the work which they have done in perfecting the organization, and bringing it to the position which it now occupies. It is far yet from what it will be, because I predict that the Technical Section will be the strongest, the most important, and the best of any division which may be created by any organization of paper manufacturers in this or any other country. This wonderful exposition of the chemical industries where we are holding our meeting is a remarkable evidence of the scientific development of the country. As these meetings continue from year to year, I predict that they will grow in attendance and interest.

"Your work brings together executives, superintendents, chemists, engineers, and other technical men from all lines, kinds, and grades of pulp and paper. You are different from any other division of the American Paper and Pulp Association in that respect, and that is why you are so important to the industry as a whole.

"We paper manufacturers compete with foreign trade and therefore must develop the technical side. I know of many mills employing technical men today that would have considered this unnecessary a few years ago. Today, however, those technically trained men are making money for those mills, and that is where the Technical Section is going to help the industry in a way in which the American Paper and Pulp Association could not do with any other division. I am not speaking disparagingly about the work of the other divisions, because the work laid out for them is being handled in an excellent and satisfactory way, but it is a different kind of work.

"You have on your program today papers and discussions by practical men who have "been through the mill" and know what they are talking about. These papers should be thoroughly discussed by you to bring out their full value. At your February meeting there were two or three papers presented and the first time I was in my mill after that my superintendent said "I want to belong to that Technical Section." He insisted on my reading one of these papers and said that it had given him more ideas on that particular subject than anything he has been able to get elsewhere. That is the kind of service that is going to make this Section valuable to the mills.

"I would suggest that we have a committee to which questions on technical subjects, or any questions that might come up in connection with problems that you may be working out in your own mills, can be referred, or have them handled by the secretary and have him refer them to those best qualified to give information.

"There is another matter which I believe that this section should handle. That is the question of the standardization of tests on pulps, especially as they effect imported pulps. I believe that the standardization of methods and the adoption of tests for pulps should be developed by this section.

"There is one other subject that is more to the fore today than any other in the minds of paper manufacturers, and that is the color situation. We need an American dye industry and it will have to be developed by technical men in the United States.

"I am pleased to see so many at this meeting. There will be various committees appointed today whose success depends on the active help given by their members. If you will really do your part you will have an organization that is worth while. I feel sure that when you meet again in February you will have three or four times as many present as you have this morning."

Thomas J. Keenan, as secretary, reported that the membership had increased from 30 in February to 125 in September, 1915.

Henry F. Obermanns of the Hammermill Paper Co. reported on the recent meeting of the German Association of Cellulose and Paper Chemists and Engineers which he attended. He told about the remarkable progress made in the science and art of papermaking in that country and pointed out how considerable credit for this improvement was due directly to the work of the association.

Otto Kress of the Forest Products Laboratory advocated the standardization of chemical tests and mill control. He outlined the difficulties that were overcome in the leather industry to achieve this, and enumerated many of the benefits that resulted from their adoption. A procedure for considering and establishing standard testing methods followed.

W. G. MacNaughton presented a resolution which was adopted providing that active membership in the section not be restricted to employees of member companies of the American Paper and Pulp Association.

Upon the adoption of a resolution presented by H. P. Carruth, the chairman appointed the following committees to investigate and report at a future meeting on the methods of analysis for control: Martin L. Griffin of the Oxford Paper Co. for soda pulp; Robert B. Wolf of the Burgess Sulphite Fibre Co. on sulphite pulp; Otto Kress of the Forest Products Laboratory on sulphate pulp; D. L. Bellinger of Finch, Pruyn & Co. on mechanical pulp, and H. P. Carruth of the American Writing Paper Co. on papermaking materials.

Martin L. Griffin advocated that means be taken to give the manufacturer of pulp some accurate method of buying wood and deplored the custom of buying by cord measure instead of by weight.

Henry F. Obermanns recommended that a committee be appointed to look into the practicability of starting a bibliography since such information would be of great value to the industry. This was referred to the Publication Committee.

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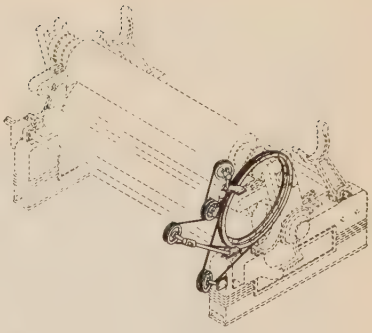
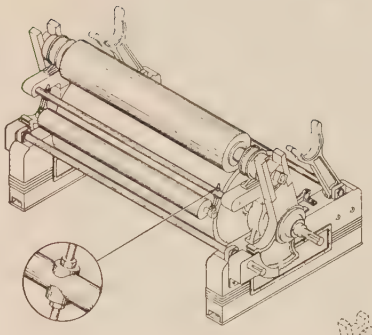
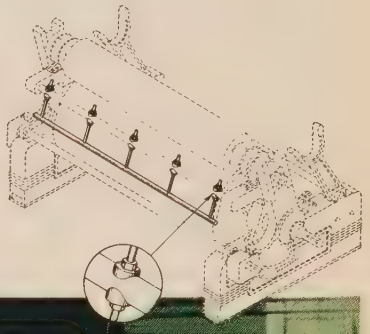
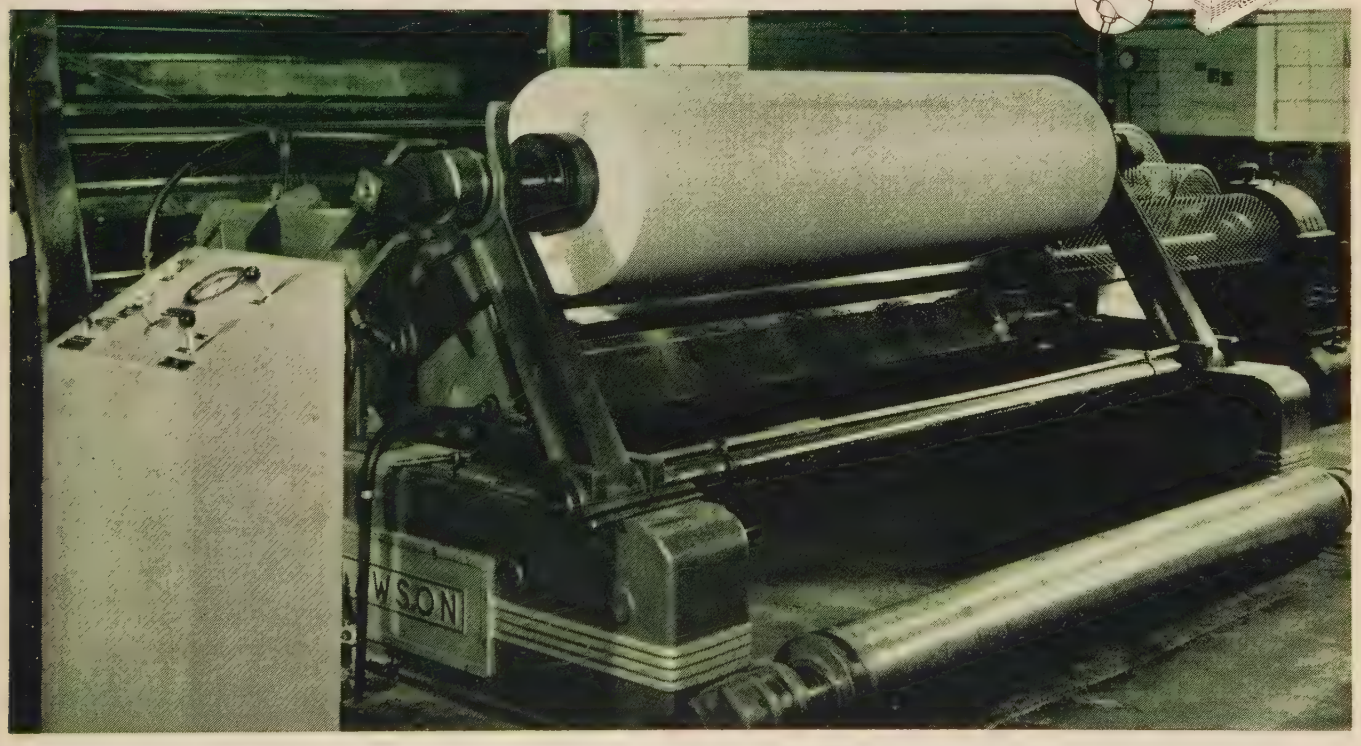




Basic reel with high crowned spreader roll

Adjustable spreader bar





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The presentation of technical papers was next in order.

D. L. Bellinger presented a paper on "Some Experiences in Refining Groundwood Slivers." This was followed by a motion picture showing the mill operation of the District of Columbia Paper Co.

Following a luncheon F. B. Wheeler of the Kimberly-Clark Corp. talked on "A Method of Determining the Current Capacity of a Cell in an Electrolytic Bleach Plant."

This was followed by a paper by Max Cline of the International Paper Co. on "The Possibilities of Accurate Determination of Groundwood in Paper."

H. P. Carruth discussed "The Relation of Ink and Paper in Halftone Printing."

I. F. Stone, president of the National Aniline and Chemical Co. was present and commented on the dye situation, a vital subject at the time in view of the scarcity due to European conditions. Up to 1915 European factories supplied about 80% of the dyes used in the American industry. Benzol, the base of aniline colors, cost 75¢ a gal. from American producers although it could be imported from Germany for 20¢ a gal. Paper blue, produced from toluol made by Americans cost about $5.00 per lb, and could be imported at a price of 50¢. He stressed the need of a protective tariff too in order to make these and other dyes in the United States.

The final paper was on "The Elimination of Fuzz in Soda Pulp by Proper Cooking Conditions" by S. D. Wells. In Mr. Wells' absence the paper was read by Otto Kress.

Following the meeting the following editorial comment appeared in the *Paper Trade Journal:* "For the past 15 years there has been a gradually increasing realization that, in order to compete with other nations and to overcome our wasteful methods, we should have to develop the technical side of our industry, as we could no longer rely upon the great advantages of abundant and cheap raw material which we had hiterto enjoyed. Since that time, over a dozen years ago, the leading companies in the industry have gradually paid more attention to the technical side of papermaking, and, in consequence, have established laboratories, not only for the testing of the raw materials which they bought in the open market, but also for the testing out of formulas of their various processes, chemical as well as mechanical.

"By bringing together these forces which relate to the technical side of the industry, the Technical Section of the American Paper and Pulp Association has taken an important step toward putting the industry on a par with any in Europe, and will do much toward improving conditions in our mills, reducing the cost of operation and improving the quality of the product. All these things will make for the betterment of the paper industry as a whole, as the information of all will be exchanged, thus improving conditions in general.

"The open meeting of the Technical Section, held in New York recently, might thus be termed *the beginning of a new era in the American industry* in which science will take the lead and be our chief resource, instead of abundant raw materials and quantity methods which have heretofore characterized the American papermaking industry."

Meeting of Feb. 16–17, 1916

Preceding the first annual meeting of the section the Executive Committee met and discussed some proposed changes in the constitution, finances, etc. An interesting feature of the informal proceedings was a discussion of methods of estimating the wet and air-dry contents of pulp in wood. The participants included R. B. Wolf, W. G. MacNaughton, K. H. Knudsen, H. K. Moore, M. L. Griffin, Otto Kress, D. L. Bellinger, and others. The remarks of Mr. Wolf formed an especially valuable contribution to the knowledge of the subject and led Mr. Griffin to say that many a manufacturer of pulp would have gladly given the amount of his week's expenses at the Waldorf-Astoria to be present and take part in the discussion.

After calling the meeting to order, Chairman Fletcher introduced Dean Hugh P. Baker of the New York State College of Forestry who described forest statistics and conditions in the Empire State.

This was followed by the presentation of a resolution reported by D. L. Bellinger for the Committee on the Revision of that Constitution as follows:

Resolved, that the name of this organization be changed from Technical Section of the American Paper and Pulp Association to the Technical Association of the Pulp and Paper Industry.

The motion was seconded by Max Cline and being put to vote was unanimously carried. Mr. Fletcher explained the change in name as necessary in order to keep the organization allied with the parent association and with other associations constituting the different divisions of the industry in affiliation with the American Paper and Pulp Association.

At this time a resolution proposed by R. B. Wolf providing that officers be eligible for re-election and a resolution proposed by H. P. Carruth as chairman of the Membership Committee providing for the addition of a junior grade of membership and revising the dues rates were adopted.

President Moore of the A.P.P.A. was present and said "I can see where the practical work is being done and that the practical men are here. This is the best attended meeting I have known since I have been engaged in association work here and I want to congratulate Mr. Fletcher and his associates on preparing a program capable of bringing together so many practical men to meet here and discuss processes, and to exchange ideas that will produce results."

Mr. MacNaughton reported for the Executive Committee as follows:

"I will say for the Executive Committee of this year, which we feel has been a year of formation for the Technical Association, that we have been very much encouraged by the response to the opportunity given the technical men of the pulp and paper industry to associate themselves together for mutual interest.

"We feel that the Technical Association of the Pulp and Paper Industry has been started on a firm basis, and we hope that it will grow in importance as well as in numbers and quality so that as the years go by the Technical Association will be regarded as a high class engineering and technical organization which will not only tend to the quality of the members connected with the industry, but also affect the practical operation of the mills, because, after all, any changes, particularly

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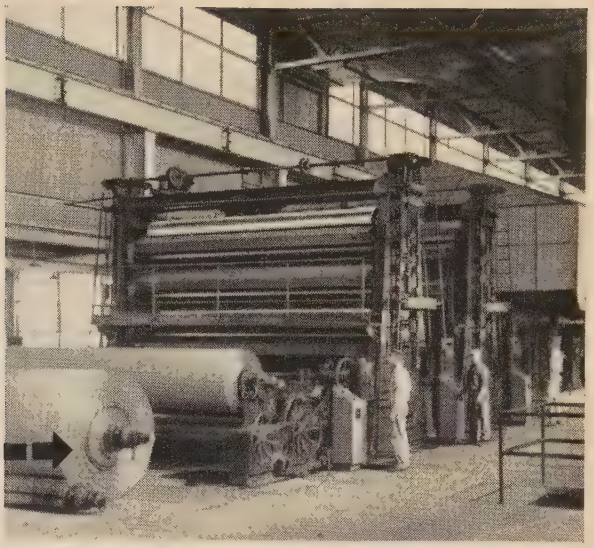

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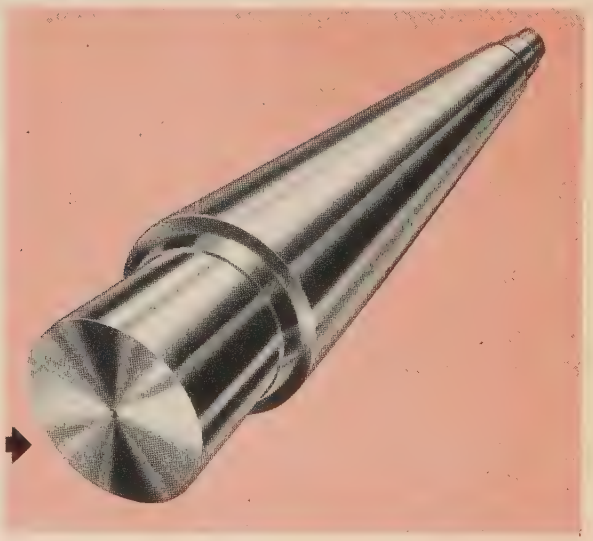

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in the practical mechanical results, are the results used to gage the success of the Association."

Secretary Keenan reported that the membership had been increased to 207. The income was $1005, and the expenses $706.90.

Chairman Fletcher then introduced Henry W. Stokes who had made the motion the preceding year creating the organization and asked him to tell the gathering what he thought of the results. Mr. Stokes said, in part:

"I think the Association is doing pretty well. A year ago there were 20 present and today more than 100. Next year we should have many more.

"I have been interested in the paper business a great many years and have done a great deal of work to find short cuts and make more money. It is very interesting work. You will find a very big field, always leading on to something more and better. You shut up one hole, then find another which if not shut up will be responsible for a big waste."

H. P. Carruth reported for the Committee on Methods of Testing who announced the following personnel of the subcommittees: Rosin and Rosin Size—Max Cline, R. C. Griffin, C. C. Heritage, and C. A. Lunn; Animal Size Stock and Glue—H. P. Carruth, F. W. Farrell, and James Murray; Starch and Starch Derivatives—H. P. Carruth, John Traquair, and G. M. McNider; Pulp Tests for Physical and Chemical Qualities—R. S. Hatch, Sidney E. Lunak, and L. H. Shipman; Fillers—Max Cline, James Murray, and Alexander W. Macvie; Chemicals—Max Cline, H. J. Skinner, and J. D. Rue; Colors, Dyes and Pigments—R. S. Hatch, Otto Schutz, (O. T. Chalon) Ludwig Strepp; Rag Moisture Test—R. S. Hatch; Rag half-stuff—H. P. Carruth; and Coating Materials—Max Cline and E. Sutermeister.

Ernst Mahler, speaking on the scarcity of dyestuffs said:

"The most important question facing us today is the dyestuff situation. You have all read a very interesting article regarding the sale of fake dyestuffs at the present time, and I think that everyone here can tell his own story about this kind of business of mixtures of yellow ochre and chrome paint, etc.

"We are, today, having more dyestuffs offered in 1 week than was previously imported in 6 months. It would be a good idea if some of the members with laboratories in the east would give us some definite information concerning the character of the dyestuffs on the market at the present time and also to keep us posted about the progress that the American dyestuff industry in making. It is time to come down to facts."

Mr. MacNaughton suggested that a committee on dyestuffs be appointed. In this connection Mr. Mahler said:

"My idea is not so much, at the present time, to determine standard methods of testing, because there really is nothing to be tested since there is nothing available. I rather thought that some men like Mr. Schutz (O. T. Chalon) and Mr. Strepp, of our Association, who are recognized authorities on dyestuffs, might keep this organization informed on progress, and perhaps give inside details of what might be of value to us, especially as to where we should keep our hands off. We are scattered all over the country, and I personally, try to keep track of the dyestuff situation because I was formerly connected with the industry, but when I came to New York I found that I have overlooked a great deal and that gave me an idea of proposing this committee."

The chairman thanked Mr. Mahler and immediately appointed Otto Schutz chairman of a committee to investigate the production and sale of adulterated dyestuffs, naming Ludwig Strepp and H. K. Moore as associates.

Otto Kress as chairman of the nominating committee then presented its selection of a slate of officers. These were: President—Harry E. Fletcher; Vice-President—W. G. MacNaughton; Secretary-Treasurer—Thomas J. Keenan; Executive Committee—Charles F. Rhodes (1 year), Henry F. Obermanns (2 years), and Ernst Mahler (3 years). These candidates were unanimously elected.

In the afternoon a group of technical papers were presented as follows:

"Some Methods for the Study of Beating" by Arthur B. Green, S. D. Warren Co.

"Proper Reforestation" by Ralph H. McKee, University of Maine.

"The Crane System of Regulating the Heat of Driers" by J. O. Woodson, Crane Co.

"The Operation of Tumbling or Drum Barkers" by Herbert Guettler, American Barking Drum Co. (Paper read by Mr. MacNaughton in Mr. Guettler's absence.)

"A Protective Device for Paper in Rolls" by F. R. Misegades.

"A Paper Problem at the Pulp and Paper School of the University of Maine" by J. N. Stephenson, University of Maine.

MEMBERS OF THE TECHNICAL ASSOCIATION IN 1916–17

The following are the members of the Technical Association of the Pulp and Paper Industry in 1916–17, the first year of its formal organization. As has been recounted, the Association was founded in 1915 as the Technical Section of the American Pulp and Paper Association, and the following year assumed its independent status under its present name. The company affiliations refer to the positions held at the time.

Members

Bacon, Charles B., Asst. Chemist, Bureau of Standards, Washington, D. C.

Bagg, John L., Clerk, Parsons Paper Co., Holyoke, Mass.

Baker, Hugh P., Dean, N. Y. State College of Forestry at Syracuse University, Syracuse, N. Y.

Barker, E. R., Chemical Engineer, Boston, Mass.

Barlow, Cone, Engineer, Munising Paper Co., Munising, Mich.

Behrend, Ernst R., President, Hammermill Paper Co., Erie, Pa.

Bellinger, D. L., Engineer, Finch, Pruyn & Co., Glens Falls, N. Y.

Berger, O. L., Superintendent Nekoosa-Edwards Paper Co., Port Edwards, Wis.

Beveridge, F. Norman, General Superintendent, Dryden Timber & Power Co., Ltd., Dryden, Ont.

Bowers, John A., Chief Chemist, Hammermill Paper Co., Erie, Pa.

Brassington, John W., Efficiency Engineer, Pusey & Jones Co., Wilmington, Del.

Bray, Paul DeC., Chemist, Katahdin Pulp & Paper Co., Lincoln, Me.

Bright, Charles G., Chemist, Kimberly-Clark Co., Neenah, Wis.

Buck, Lucien, Purchasing Engineer, Eastman Kodak Co., Rochester, N. Y.

Bullard, H. F., Chemist, Laurentide Co., Ltd., Grand Mere, Que.

Caldwell, Winthrop E., Efficiency Engineer, American Writing Paper Co., Holyoke, Mass.

Carey, James L., Paper Mill Architect and Engineer, Chicago, Ill.

Carruth, Henry P., Chief Chemist, American Writing Paper Co., Holyoke, Mass.

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It may well be that some obstacle in efficient sizing, or foam dispersal, or pitch control, which has your staff stumped right now, is one that our laboratory removed only last month for some manufacturer a thousand miles from you.

In the pilot plant in Nopco's Research Laboratories, these men work constantly (when they're "at home") on practical problems submitted to them from mills the country over. They don't know all the answers yet, but they have helped many mills to produce a better sheet of paper, at lower cost.

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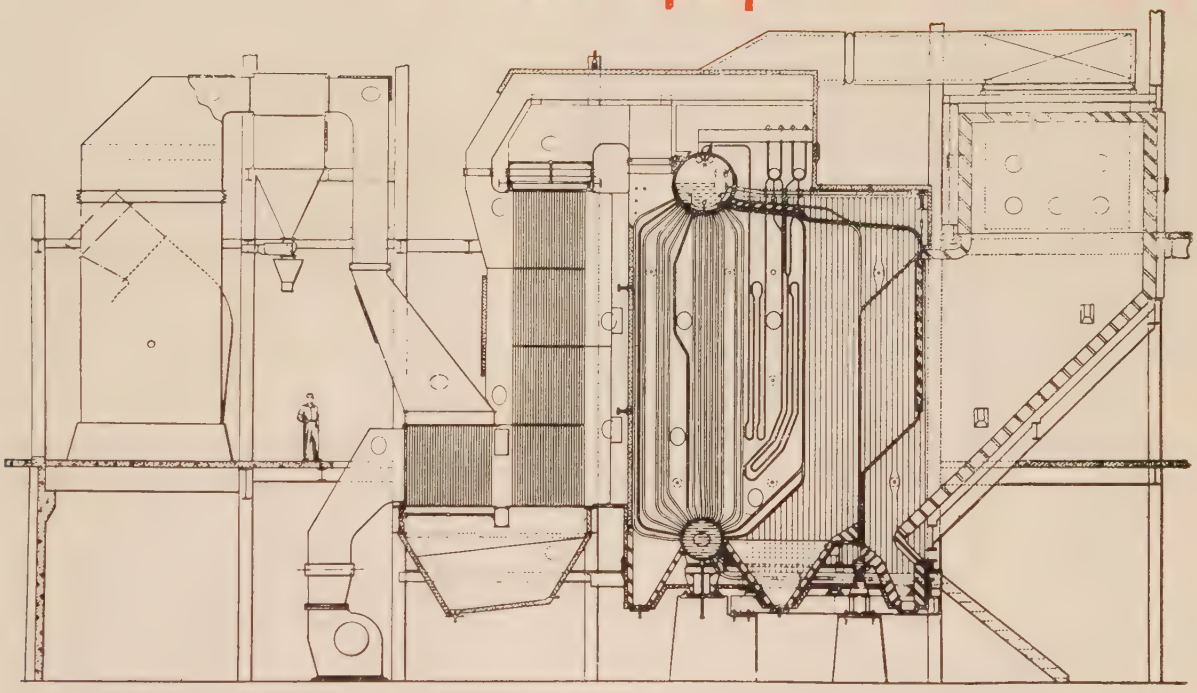
Clark, Fred. C., Paper Laboratory, Bureau of Standards, Washington, D. C.
Clark, Gilbert L., Chemist, Emerson Laboratory, Springfield, Mass.
Cline, Max, Chemist, Bureau of Tests, International Paper Co., Glens Falls, N. Y.
Cronkhite, W. W., Commercial Engineer, General Electric Co., Schenectady, N. Y.
Cunningham, John H., Laurentide Co., Ltd., Grand Mere, Que.
Curtis, Frederick A., Chemist, Aetna Paper Co., Dayton, Ohio
Davis, John F., Superintendent, Beckett Paper Co., Hamilton, Ohio
Davis, Merritt J., Chemist, Taggart Bros. Paper Co., Watertown, N. Y.
Davis, W. L., Jr., Assistant Superintendent, Dells Paper & Pulp Co., Eau Claire, Wis.
DeCew, J. A., Chemical Engineer, Montreal, Que.
Dickerson, Walter H., Manager and Secretary, Muskegon Extract Co., Muskegon, Mich.
Douglass, Harry E., Chemist, Fletcher Paper Co., Alpena, Mich.
Drake, C. W., Industrial Engineer, Westinghouse Electric & Mfg. Co., Chicago, Ill.
Emerson, Herbert C., President, Emerson Laboratories, Springfield, Mass.
Farrell, Frederick W., Chemist, Ideal Coated Paper Co., Brookfield, Mass.
Fletcher, Harry E., Secretary and General Manager, Fletcher Paper Co., Alpena, Mich.
Fletcher, Philip K., Foreman, Bleach and Electrolytic Departments, Pennsylvania Salt Mfg. Co., Wyandotte, Mich.
Forrester, George W., Beater Engineer, American Writing Paper Co., Holyoke, Mass.
Frank, J. J., Asst. Manager, Ancram Paper Mills, New York, N. Y.
Franke, K. W., Chemist, Hinde & Dauch Paper Co., Sandusky, Ohio
French, Hobert W., Chemist, Tileston & Hollingsworth Co., Hyde Park, Mass.
Gleason, E. P., Asst. Engineer, Nekoosa-Edwards Paper Co., Port Edwards, Wis.
Gleason, G. H., Chemical Engineer, Boston, Mass.
Green, Arthur B., Industrial Engineer, S. D. Warren, Cumberland Mills, Me.
Griffin, Martin L., Manager of Chemical and Electrochemical Departments, Oxford Paper Co., Rumford, Me.
Griffin, Roger C., Chief Analyst, Arthur D. Little, Inc., Boston, Mass.
Gschwender, Ernst, Draftsman and Engineer, Detroit Sulphite Pulp & Paper Co., Detroit, Mich.
Guettler, Herbert, Manager, American Barking Drum Co., Chicago, Ill.
Guild, Henry J., Research Manager, Eastern Mfg. Co., Bangor, Me.
Hafele, J. Ernest, Chemist, Robert Gair Co., Brooklyn, N. Y.
Hall, Keppele, Engineer in Charge of Taylor System of Scientific Management, Eastern Mfg. Co., Bangor, Me.
Hammond, H. B., Sales Engineer, Westinghouse Electric & Mfg. Co., New York, N. Y.
Hartman, August F., Office Foreman, George F. Hardy, New York, N. Y.
Hatch, Raymond S., General Superintendent, Crocker McElwain Co., Holyoke, Mass.
Haug, F. Anton, Engineer, Improved Paper Machinery Co., Nashua, N. H.
Haynes, Edward A., General Manager, Port Huron Paper Co., Port Huron, Mich.
Hedden, Morris W., Chemical Engineer, Crown Williamette Paper Co., West Linn, Ore.
Hedin, Joseph E., Manager, Jessup & Moore Paper Co., Wilmington, Del.
Heiskenan, Jalmar E., Designing Engineer, The Moulton Engineering Corp., Portland, Me.
Hockley, Claude C , Manager o Manufacturing, St. Maurice Paper Co., Cap Magdeleine, Que.
Hyatt, Frank R., in Charge of Mechanical Testing, Bureau of Tests, International Paper Co., Glens Falls, N. Y.
Jenssen, G. D., Consulting Engineer, G. D. Jenssen Co., New York, N. Y.
Jenssen, J. D., Consulting Engineer, G. D. Jenssen Co., New York, N. Y.
Jones, Edward A., E. D. Jones & Sons Co., Pittsfield, Mass.
Keenan, Thomas J., Editor of *Paper*, New York, N. Y.
Kent, Charles H., Chemist, Vera Chemical Co., Stoneham, Mass.
Ketchen, W. L., Construction Engineer, Riordon Pulp & Paper Co., Ltd., Hawkesbury, Ont.
Kleiner, E. G., Chemical Engineer, New York, N. Y.
Knudsen, K. Hv., Chemical Engineer, New York, N. Y.
Kress, Otto, in Charge of Section of Pulp and Paper, Forest Products Laboratory, Madison, Wis.
Lauroesch, Hugo V., Defiance Paper Co., Niagara Falls, N. Y.
Little, Arthur D., Chemist, Arthur D., Little, Inc., Boston, Mass.
Low, Emile R., Assistant Production Manager, Beaver Board Co., Buffalo, N. Y.
Lunak, S. E., Chemist, Forest Products Laboratory, Madison, Wis.
Lunn, Charles A., Technical Director, Central Naval Stores Co., New York, N. Y.
McDowell, Charles, President, McDowell Paper Mills, Manayunk, Pa.
McIntyre, A. G., General Manager, Mattagami Pulp & Paper Co., Toronto, Ont.
McKee, George M., General Manager, Donnacona Paper Co., Ltd., Donnacona, Que.
McKee, Ralph H., Director of Pulp and Paper School, University of Maine, Orono, Me.
McNaughton, George C., Engineer in Forest Products, Forest Products Laboratory, Madison, Wis.
MacDiarmid, Archibald A., chief engineer, Mattagami Pulp & Paper Co., Toronto, Ont.
MacNaughton, W. G., in Charge of Manufacturing, Nekoosa-Edwards Paper Co., Port Edwards, Wis.
MacNider, George M., Chemist, Corn Products Refining Co., New York, N. Y.
Macvie, Alex. W., Chemist and Expert, Bryant Paper Co., Kalamazoo, Mich.
Mahler, Ernst, Asst. General Superintendent, Kimberly-Clark Co., Kimberly, Wis.
Mason, J. O., Manager of Manufacturing, Laurentide Co., Ltd., Grand Mere, Que.
Matheson, Einar, Efficiency Engineer, St. Croix Paper Co., Boston, Mass.
Maxwell, Orin P., Chemist, West Virginia Pulp & Paper Co., Luke, Md.
Mead, George H., President, Mead Pulp & Paper Co., Dayton, Ohio
Millspaugh, W. H., Sandusky Foundry & Machine Co., Sandusky, Ohio
Moe, Carl, Chemist, Louisiana Fibre Board Co., Bogalusa, La.
Moore, Edward T., Engineer, Westinghouse Electric & Mfg. Co., Syracuse, N. Y.
Moore, Hugh K., Chief Chemist and Chemical Engineer, Berlin Mills Co., Berlin, N. H.
Morrison, Freeland J., Chemist, Oxford Paper Co., Rumford, Me.
Morse, E. S., Commercial Engineer and Salesman, Westinghouse Electric & Mfg. Co., Boston, Mass.
Murray, James, Chemist, Nashua Gummed & Coated Paper Co., Nashua, N. H.
Nixon, William L., General Superintendent, Chemical Paper Mfg. Co , Holyoke, Mass.
Nunez, Vasco E., Research Chemist, Arthur D. Little, Inc., Boston, Mass.
Oberdorfer, Max, Engineer and Chemist, Central Paper Co., Muskegon, Mich.
Obermanns, Henry F., Assistant to President, Hammermill Paper Co., Erie, Pa.
Outterson, J. A., President, Carthage Sulphite Pulp & Paper Co., Carthage, N. Y.
Patrick, Stephen E., S. D. Warren Co., Westbrook, Me.
Paulson, P. A., Superintendent of Sulphite Mill, Kimberly-Clark Co., Neenah, Wis.
Prather, H. B., Cleveland, Ohio
Rausch, Roswell H., Engineer, Bureau of Tests, International Paper Co., Rumford, Me.
Rhodes, Charles F., Superintendent, Bureau of Tests, International Paper Co., Glens Falls, N. Y.
Richardson, Wilbur P., Asst. Superintendent and Chemist, Hinckley Fibre Co., Hinckley, N. Y.
Ripley, C. E., Consulting Engineer, New York, N. Y.
Robertson, Reuben B., General Manager, Champion Fibre Co., Canton, N. C.
Robertson, W. F., Co-partner, E. C. Robertson & Son, Hinsdale, N. H.
Rothschild, Henry A., Chemist, Kimberly-Clark Co., Neenah, Wis.
Rue, John D., Professor, University of Michigan, Ann Arbor Mich.
Sanburn, Justus C., Chemist, Strathmore Paper Co., Mittineague, Mass.
Schenck, Jr., Garrett, in Charge of Testing and Economy Work, Great Northern Paper Co., Millinocket, Me.
Schutz, Otto, Paper and Pulp Expert, Badische Co., New York, N. Y.

2 B&W MgO RECOVERY UNITS to serve pulp mill in ALASKA



Ketchikan Pulp Company—the first pulp mill in Alaska—will produce dissolving pulp employing the Magnesium Bisulphite (MgO) process. This will be the first new plant to use this process.

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In addition to the recovery units, two B&W two-drum Stirling boilers are on order, to be fired with oil and bark. Each power boiler will generate 160,000 lb of steam per hour at 860 psi and 825 F total steam temperature.

B&W invites your inquiries relating to heat and chemical recovery problems for both the sulphite and sulphate pulping processes. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

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BOILER DIVISION

P-779

Scott, Douglas E., Asst. Chemical and Experimental Papermaker, A. D. Little, Inc., Boston, Mass.
Scott, Frank O., Superintendent, Southworth Co., Mittineague, Mass.
Sherman, George C., President, Taggart Paper Co., Watertown, N. Y.
Shipman, L. H., in Charge of Bleaching and Chemical Departments, Burgess Sulphite Fibre Co., Berlin, N. H.
Skinner, Hervey J., Vice-President, Arthur D. Little, Inc., Boston, Mass.
Smith, Daniel A., Vice-President and General Manager, District of Columbia Paper Mfg. Co., Washington, D. C.
Spierling, Arthur O., Assistant Mechanical Engineer, Hammermill Paper Co., Erie, Pa.
Standish, John C., Asst. Superintendent, F. C. Huyck & Sons, Albany, N. Y.
Steffanson, G. B., Consulting Engineer, Fox Paper Co., Lockland, Ohio.
Stephenson, J. N., Professor of Chemistry, University of Maine, Orono, Me.
Strachan, J. R., Chemist, Canada Paper Co., Ltd., Windsor Mills, Que.
Strepp, L., Superintendent, Badische Co., New York, N. Y.
Surface, Henry E., Engineer in Forest Products, Forest Products Laboratory, Madison, Wis.
Sutermeister, Edwin, Chief Chemist, S. D. Warren Co., Cumberland Mills, Me.
Sutherland, D. Manson, Manager, Agasote Millboard Co., Trenton, N. J.
Taylor, Howard S., Engineer, Lake Superior Paper Co., Ltd., Sault Ste. Marie, Ont.
Thorne, C. B., Mechanical Engineer and Chemist, Riordon Pulp & Paper Co., Ltd., Hawkesbury, Ont.
Thue, Jens, Sulphite Engineer, C. Bache-Wiig, Portland, Me.
Traquair, John, Vice-President and Manager, Feculose Co. of America, Ayer, Mass.
Vestesen, Borge, Chemist, St. Croix Paper Co., Woodland, Me.
Wallace, William L., Mechanical Engineer, Manitowoc Engineering Works, Manitowoc, Wis.
Wardle, Edward B., Chief Engineer, Laurentide Co., Ltd., Grand Mere, Que.
Weber, W. A. O., Special Instructor, American Writing Paper Co., Holyoke, Mass.
Wells, Sidney D., Engineer in Forest Products, Forest Products Laboratory, Madison, Wis.
Wheeler, F. G., Chemical Engineer, Kimberly-Clark Co., Neenah, Wis.
Whitney, William A., Manager, Emerson Paper Co., Wendell, N. H.
Williamson, George E., Chief Engineer, Strathmore Paper Co., Mittineague, Mass.
Winslow, Carlile P., Engineer in Forest Products, Forest Products Laboratory, Madison, Wis.
Wolf, Robert B., Manager of Manufacturing, Burgess Sulphite Fibre Co., Berlin, N. H.
Wood, Walter H., Testing Engineer, American Writing Paper Co., Holyoke, Mass.
Wyman, G. R., Manufacturing Manager, Bird & Son, East Walpole, Mass.

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Andrews, D. C. Superintendent of Sulphite Mill, Northwest Paper Co., Cloquet, Minn.
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Boyd, Charles S, Manager, Appleton Coated Paper Co., Appleton, Wis.
Bradley, P. D., Superintendent, Defiance Paper Co., Niagara Falls, N. Y.
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Campbell, William J., Superintendent of Groundwood Department, Northwest Paper Co., Cloquet, Minn.
Carrigan, J. F., Chief Engineer, Nekoosa-Edwards Paper Co., Port Edwards, Wis.
Carroll, John F., General Superintendent, Inland Empire Paper Co., Millwood, Wash.
Coffin, Arthur D., President, C. H. Dexter & Sons, Inc., Windsor Locks, Conn.
Corcoran, J. C., Salesman, Rice, Barton & Fales Machine & Iron Foundry Co., Worcester, Mass.
Cosler, Arthur S., Sulphite Superintendent, Marathon Paper Mills Co., Rothschild, Wis.
Dore, Edward A., Chemist, Bathurst Lumber Co., Ltd., Bathurst, N. B.
Dorman, Edward O., Sales Manager, Champion Coated Paper Co., New York, N. Y.
Dunn, Theodore W., Vice-President, Detroit Sulphite Pulp & Paper Co., Detroit, Mich.
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Everest, D. C., Secretary and General Manager, Marathon Paper Mills Co., Rothschild, Wis.
Ferguson, George K., Chemist, Watervliet Paper Co., Watervliet, Mich.
Fishburn, Victor Earl, Chemist, Watab Pulp & Paper Co., Sartell, Minn.
Fisk, Ira T., Superintendent, Stevens & Thompson, North Hoosick, N. Y.
Goldschmidt, David J., Secretary to General Manager, Crown Willamette Paper Co., San Francisco, Calif.
Goodell, E. G., General Manager, Louisiana Pulp & Paper Co., Braithwaite, La.
Goodnow, W. W., Asst. Treasurer, Fort Orange Paper Co., Castle-on-Hudson, N. Y.
Gordon, Forest C., Chemist, Richardson Paper Co., Lockland, Ohio
Hall, Emmett A., Secretary-Treasurer, Glens Falls Machine Works, Glens Falls, N. Y.
Helseth, S. T., Pulp and Paper Student, Oxford Paper Co., Rumford, Me.
Heritage, C. C., Chemical Engineer, Nekoosa-Edwards Paper Co., Port Edwards, Wis.
Holmes, George S., General Manager, Yellow Pine Paper Mill Co., Orange, Tex.
Howard, Guy C., Chemical Engineer, Howard Pulp Process Co., Montclair, N. J.
Howell, W. H., Jr., Superintendent, New York & Pennsylvania Co., Willsboro, N. Y.
Huyck, Edmund N., President, F. C. Huyck & Sons, Albany, N. Y.
Johnson, Wilhelm O., Superintendent Strathmore Paper Co., Woronoco, Mass.
Kennedy, Archie J., Superintendent, Sandy Hill Iron & Brass Works, Hudson Falls, N. Y.
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Lawrence, W. J., Manager, Western Paper Makers Chemical Co., Kalamazoo, Mich.
Lincoln, Winslow S., Engineering and Sales Departments, Rice, Barton & Fales Machine & Iron Foundry Co., Worcester, Mass.
Lippincott, Wilmot C., Asst. Sulphite Superintendent, Cherry River Paper Co., Richwood, W. Va.
McDonnell, Edward J., Jr., Superintendent, Tileston & Hollingsworth Co., Mattapan, Mass.
McNair, C. I., Jr., Asst. to General Manager and Superintendent, Northwest Paper Co., Cloquet, Minn.
Mann, F. A. L., Beater Engineer, Hammermill Paper Co., Erie, Pa.
Moore, Charles F., Secretary, Bureau of Statistics, Book Paper Manufacturers, New York, N. Y.
Moore, Frank L., President, Newton Falls Paper Co., Watertown, N. Y.
Murphy, Thomas R. H., Construction Engineer, Bathurst Lumber Co., Ltd., Bathurst, N. B.
Murray, Edward B., Vice-President, Union Bag & Paper Co., New York, N. Y.
Murray, Milton, Superintendent, Agawam Div., American Writing Paper Co., Mittineague, Mass.
Naylor, Alexander D., Secretary-Treasurer, American Paper & Pulp Assoc., New York, N. Y.
Nevius, A. H., General Manager, Miami Paper Co., West Carrollton, Ohio
Pagenstecher, Felix, Secretary and Manager, Riverview Coated Paper Co., Kalamazoo, Mich.
Parant, Leo J., General Superintendent, St. Croix Paper Co., Woodland, Me.
Patch, Clifford, Chemist, Orono Pulp and Paper Co., Bangor, Me.
Patterson, D. H., Jr., Superintendent, California Paper & Board Mills, Antioch, Calif.
Robinson, W. T., General Manager, Parsons Pulp & Lumber Co., Parsons, W. Va.
Schneider, Carl, in Charge of Colors and Coloring of Paper, Knowlton Bros., Watertown, N. Y.

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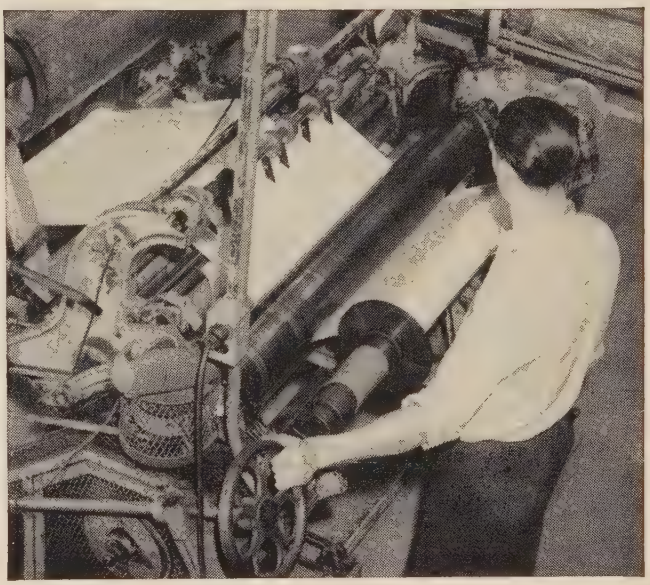

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Smith, Leonard E. Superintendent, Nekoosa-Edwards Paper Co., Port Edwards, Wis.
Snell, Ralph M., Manager, Paper Makers Chemical Co., Holyoke, Mass.
Sprang, Rudolph J., Asst. Superintendent, Champion Fibre Co., Canton, N. C.
Steele, George F., Secretary, Newsprint Manufacturers Assoc., New York, N. Y.
Strange, Hugh, Secretary-Treasurer, John Strange Paper Co., Menasha, Wis.
Straus, Raymond I., Secretary, Bedford Pulp & Paper Co., Richmond, Va.
Taylor, H. W., Vice-President, Dill & Collins Co., Philadelphia, Pa.
Taylor, John M., Manager, Diamond State Fibre Co., Bridgeport, Pa.
Uptegraff, T. M., Secretary and Treasurer, Defiance Paper Co., Niagara Falls, N. Y.
Van Alstyne, John, Superintendent of Sulphite Department, Rhinelander Paper Co., Rhinelander, Wis.
Wagg, James B., Asst. Superintendent, Strathmore Paper Co., Woronoco, Mass.
Walker, Harold E., Asst. Manager and Superintendent, John S. Moore & Son, Bellows Falls, Vt.
Warren, Francis W., Consulting Engineer, Brownville Paper Co., Brownville, N. Y.
Wilson, John H., Hydro-Electric Engineer and Superintendent of Power, Berlin Mills Co., Berlin, N. H.
Woodruff, J. B., Purchasing Department, American Writing Paper Co., Holyoke, Mass.
Yoerg, L. M., Superintendent, Carew Mfg. Co., South Hadley Falls, Mass.
Zimmerman, Max, Superintendent, Mac Sim Bar Paper Co., Otsego, Mich.
Zimmermann, Carl J., President, St. Lawrence Talc Co., New York, N. Y.

Junior Members

Coughlin, Edward Thomas H., Chemist and Chemical Engineer, Monarch Paper Co., Kalamazoo, Mich.
Holbrook, Ralph A., Chemical Engineer, Great Northern Paper Co., Millinocket, Me.
Rieser, Charles W., Chemist, American Writing Paper Co., Holyoke, Mass.

FIRST YEAR MEMBERS STILL WITH THE ASSOCIATION

The present members of the Association are listed in the current TAPPI Year Book, and membership statistics will appear in another part of this review. However, in view of its historical interest, the following lists those members who became associated with the Association in 1916–17 that are still members.

Members

Curtis, Frederick A., Chemist, Aetna Paper Co. Dayton, Ohio
Davis, John F., 33 Arlington, Cambridge, Mass.
Davis, Merritt J., President and General Manager, Hammond Bag & Paper Co., Wellsburg, W. Va.
DeCew, J. A., President, Process Engineers, Inc., Mt. Vernon, N. Y.
Fletcher, Harry E., President, Fletcher Paper Co., Alpena, Mich.
Green, Arthur B., Papres Co., Needham, Mass.
Griffin, Roger C., Needham, Mass.
Guettler, Herbert W., President, Fibre Making Processes, Inc., San Francisco, Calif.
Hatch, Raymond S., Vice-President, Hudson Pulp & Paper Co., New York, N. Y.
Haug, A. F., Mfgr. of Pulp Mill Machy., Nashua, N. H.
Hedden, M. W., Mentone, Calif.
Hyatt, Frank R., Technical Director, Johns-Manville Co., Jarratt, Va.
McKee, Ralph H., Professor of Chemical Engineering (Retired), Columbia University, New York, N. Y.
Mead, George H, Chairman of the Board, Mead Corp., Chillicothe, Ohio
Millspaugh, W. H., Sandusky, Ohio
Nunez, Vasco E., Nashua, N. H.
Richardson, Wilbur P., Asst. Superintendent, Insulation Board Mill, MacAndrews & Forbes Co., Camden, N. J.
Robertson, Reuben B., Sr., Chairman of the Board, Champion Paper & Fibre Co., Canton, S. C.
Rothchild, Henry A., Asst. to Manufacturing Vice-President, Kimberly-Clark Corp., Neenah, Wis.
Rue, John D., (Retired), Tacoma, Wash.
Skinner, Hervey J., Vice-President, American Conditioning House, Inc., Boston, Mass.
Spierling, Arthur O., Manufacturing Superintendent, Hammermill Paper Co., Erie, Pa.
Stephenson, J. Newell, Editor, *Pulp & Paper Magazine of Canada*, Gardenvale, Que.
Sutherland, D. Manson, Sutherland Refiner Corp., Trenton, N. J.
Thue, Jens, retired, Hawkesbury, Ont.

Associate Members

Baker, W. E. Byran, Manager, Paper Research, New York & Pennsylvania Co., Inc., Lock Haven, Pa.
Dunn, Theodore W., President, Dunn Paper Co., Port Huron, Mich.
Eliason, Harry D., Asst. Vice-President, Cellulose Sales Co., Inc., New York, N. Y.
Everest, D. C., Chairman of the Board, Marathon Corp., Rothschild, Wis.
Fishburn, Victor Earl, Director of Developments, Weyerhaeuser Timber Co., Tacoma, Wash.
Heritage, C. C., Tacoma, Wash.
Murphy, Thomas R. H., Consulting Engineer, Mead Investment Co., Dayton, Ohio
Patch, Clifford, Technical Director, Eastern Corp., Bangor, Me.

THE PRESIDENTIAL ADMINISTRATIONS

Thirty-one large volumes of *Technical Assocation Papers* and since January, 1949, the Association's magazine *Tappi*, in monthly issues, have been published giving in detail the story of the activities and accomplishments of the Association since it was organized.

For the purpose of this review only the highlights of the Association's history will be mentioned and considered in terms of the administrations of the various presidents of the organization.

In the historical record concerning the founding of the Association considerable information is given in regard to the contribution made by Harry Fletcher. It will, therefore, not be reviewed further here.

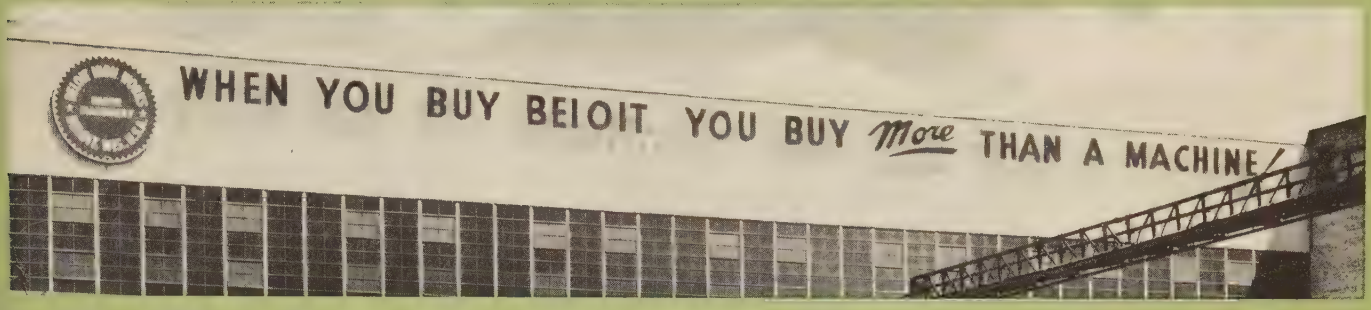
Harry P. Carruth and W. G. MacNaughton

William G. MacNaughton was elected to the presidency in 1917 but since he transferred his activities from the Nekoosa-Edwards Paper Co. in Port Edwards, Wis., to the Inland Empire Paper Co. in Spokane, Wash., soon thereafter, he resigned and was replaced by Harry P. Carruth of the American Writing Paper Co. who served in 1917 and 1918 and was one of the founders of

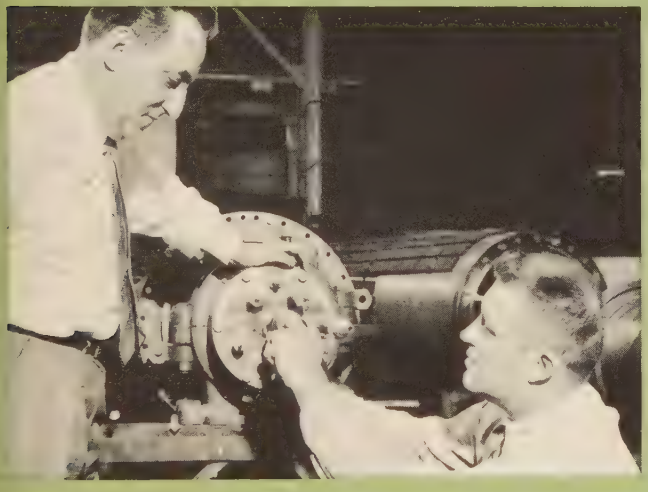
H. E. Fletcher
1915–1916

W. G. MacNaughton
1917

The Beloit Album



VISITORS TO BELOIT IRON WORKS, Beloit, Wisconsin, are greeted by this familiar sign extending for more than a hundred feet across the top of the pipe roll shop. From this huge plant, established in 1858, comes Beloit papermaking machinery known throughout the world. Currently under way is a gigantic expansion program which, when completed, will add over 176,000 square feet of manufacturing area to the 17.5-acre plant. A pictorial progress report appears on the following pages.



ITALIAN VISITOR Dr. Piero Bersano *(left)*, Technical Director of Cartiere Burgo, Torino, Italy, and Beloit's Foreign Sales Representative, C. K. Pfrangle, examine a Beloit suction box on the suction roll erecting floor, Beloit.

ROBERT GAIR'S William Schnorbach *(left)* recently visited Beloit to discuss the design of a new Kraft Paper Machine. Mr. Schnorbach is shown discussing specific details with Beloit Sales Engineer C. H. Swartz.

BOWATERS NEWFOUNDLAND Plant Engineer F. Dickson *(left)*, General Superintendent Newsprint H. A. Kelly, Research and Development Engineer M. C. Collins, and Beloit Sales Engineer A. G. Olson visit the main erecting floor to examine an Air-cushioned Inlet designed for a high-speed newsprint machine. An inlet, similar to the one pictured above, is installed on Bowaters' recordbreaking No. 1 newsprint machine at Calhoun, Tennessee.

TREES FOR TOMORROW 20,000 Norway pine and spruce were planted recently on property near Beloit Iron Works. P. J. Onkels, Mill Manager, Pacific Coast Paper Mills, stopped in to watch the planting. *(l. to r.)* R. A. Goodwillie, Beloit West Coast Representative; Mr. Onkels; W. S. Wood, Beloit Vice President; and William Sylvester, forester with Trees for Tomorrow, Inc., an industry-sponsored organization for the advancement of reforestation.

Beloit's Expansion Program

Vigorous expansion has been the watchword of the pulp, paper, and paperboard industry over the last decade.

To supply the needs of its customers, Beloit Iron Works has undertaken an almost continuous program of expansion and development. This issue of the Beloit Album brings you a pictorial progress report on our current expansion program.

The new suction roll and drive erecting floors—11,000 square feet—were occupied June 1, 1955. The welding shop addition, over 10,000 square feet, and the new machine shop, over 32,000 square feet, will be completed by the time this issue of the Beloit Album reaches you. Enlargement of the main

foundry bay, a new dryer and roll casting floor, new core room, and expanded storage facilities—totaling over 100,000 square feet—will be completed during 1956. Foundry plans also include the installation of new melting, moulding, and sand-system facilities.

Plant engineers have carefully planned and checked each detail of construction and tooling. High-speed modern machine tools, planers, lathes, boring bars, gear hobbers, and milling machines, to mention just a few, are being installed as quickly as space is available. These new tools, plus careful rearrangement of existing facilities, all add up to one thing—better service.

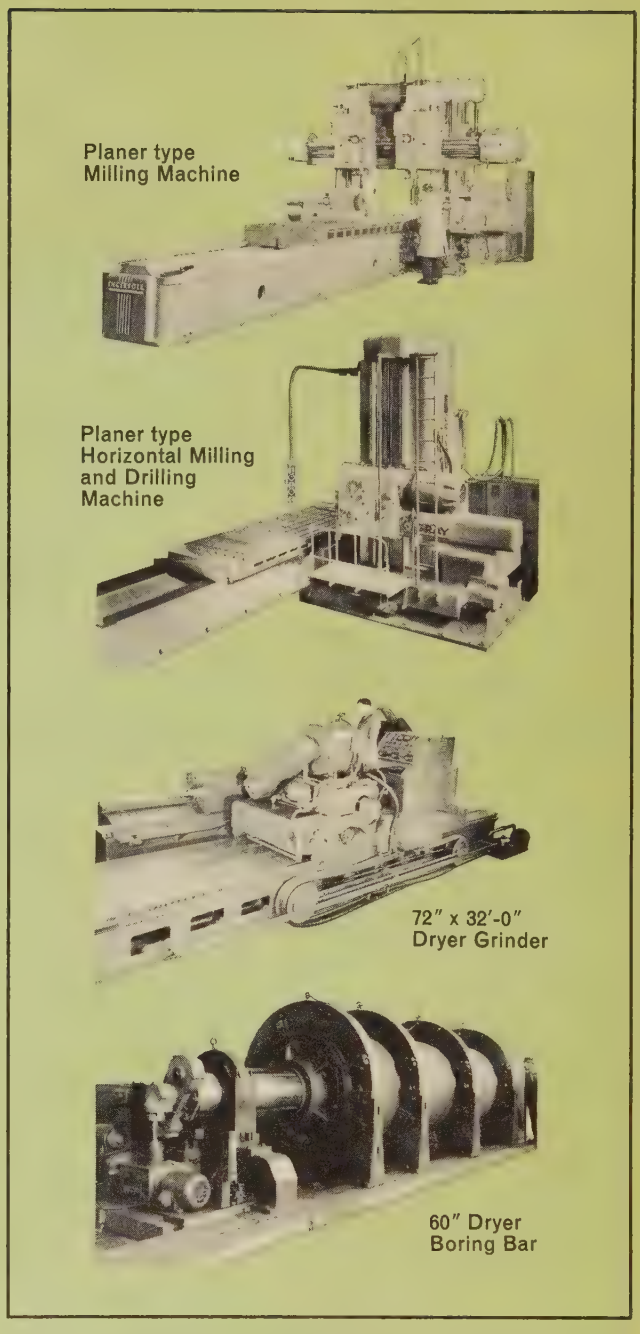
An expansion program means more than buildings and tools. It means people—highly trained personnel ready to translate customer requirements into completed papermaking machinery. Beloit Iron Works, now employing more than 2,000 capable men and women, anticipates a payroll of 2,300 persons when this expansion is completed.

NEW MACHINE SHOP *(above)*, over 32,000 square feet, will house planer millers and large boring bars. A 20-ton bridge crane and 7½-ton floor-controlled crane will service these machine tools. Balcony area will provide increased room for stock storage, making more parts readily available to meet customer requirements.

CONSTRUCTION WORK *(below)* goes on high above floor of welding department addition. New welding shop (10,000 square feet) will provide space for larger, longer fabrications. An automatic welding machine, capable of handling beams 70 feet long, has been installed. Straighteners, grinders, and a sand-blasting unit have been added to the welding department's tool roster.

ADDITION *(above)* adds 11,000 square feet to suction roll and drive erecting floors, increases total erecting areas to over 33,000 square feet. Space will be used to assemble and check each unit before it leaves Beloit shops.

HUGE PIT *(below)* will provide additional 100,000 square feet of foundry space, more than enough to offset demand for castings created by machine shop expansion. Facilities will be installed for casting rolls and dryers 360 inches long. Pumps control seepage below level of Rock River.



Above: A few of the machine tools that are being added to Beloit shops during plant expansion.

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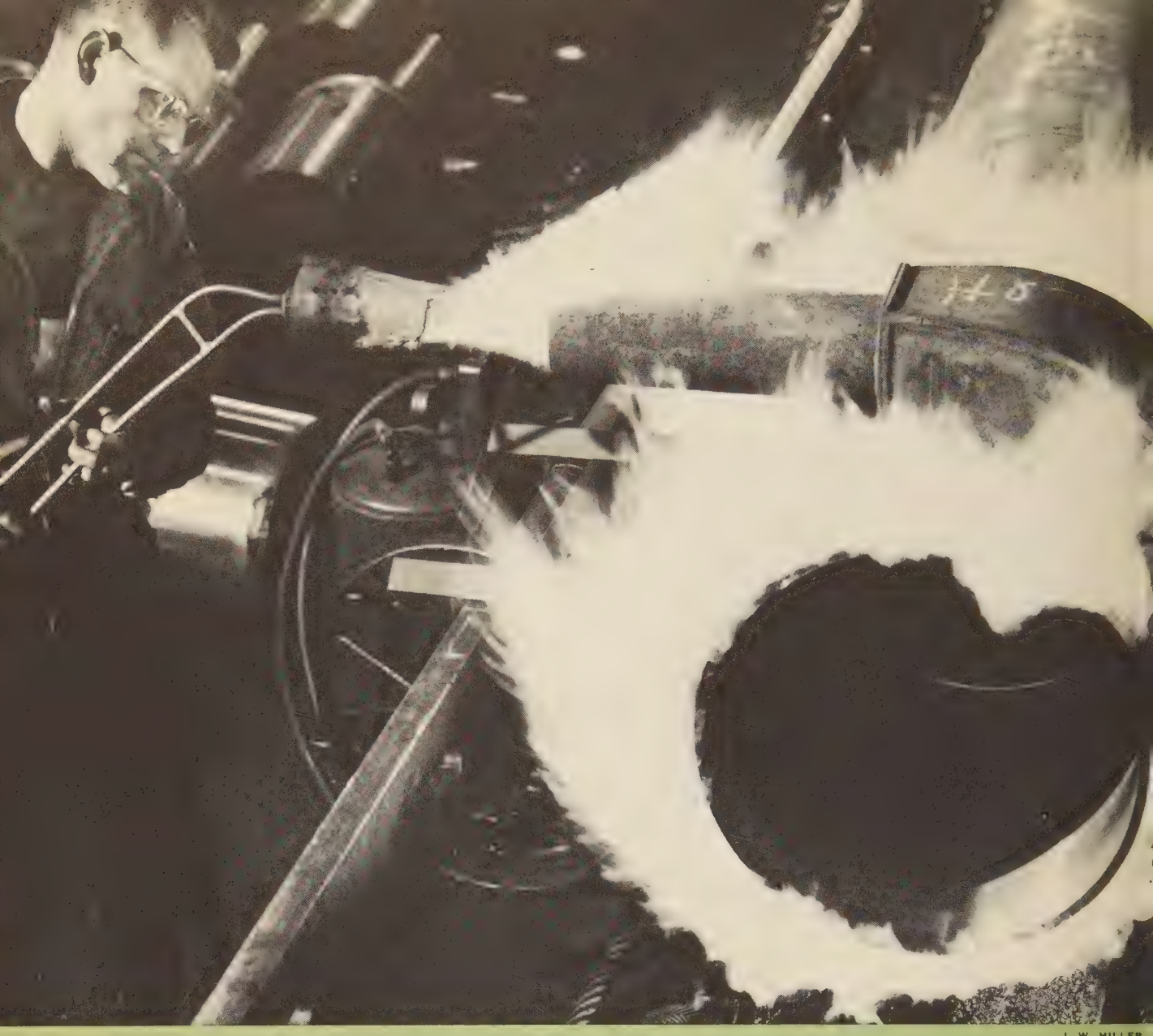

J. W. MILLER

"THE HEAT'S ON"—In the photograph above, "Pete" Landis, hydraulic press operator in the Beloit Iron Works pipe roll shop, is seen preparing a 20-inch reel spool body for the head fit. The head will be inserted into the machined and heated pipe. Contraction of the cooling pipe will clamp the head in place.

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the Association. Henry F. Obermanns of the Hammermill Paper Co. was vice-president.

In response to a request from the secretary to point out some of the outstanding events of 1917–18, Mr. Carruth on the occasion of the Twenty-Fifth Anniversary wrote as follows:

"I find that the intervening twenty odd years since I was president somewhat obscures the recollection of details. I recall, however, the definite impression of the youth of the Technical Association in contrast with the older organizations of the industry, and the consequent more or less paternalistic attitude of the other associations. The Association was then as now, but perhaps militantly then, an organization of individuals most of whom were rather young and their functions in the industry much less well established than is now the case. It was always more or less a struggle to maintain this independence and separate entity of TAPPI than is now conceivable.

"It was during this period that the initial work on the preparation of textbooks was first undertaken. Our income in those days was quite modest, and an undertaking such as the textbooks was in consequence a considerable problem. Above everything else, I remember the wonderful enthusiasm and good fellowship which was so much in evidence at our meetings.

"The relatively small membership at that time permitted intimacy of acquaintanceship no longer possible. My recollection is that their winter meetings were then held in the old Waldorf, and that the two fall meetings, during my administration, were held respectively at Holyoke, Mass., and Dayton, Ohio. There is a similarity between those years and the present time. We were arming then as we are today, problems of priority, problems arising out of scarcity of raw materials were much in people's minds, and Government needs for chlorine disturbed the industry as today."

In supplementing Mr. Carruth's comments it may be pointed out that the Holyoke meeting referred to was held jointly with the Technical Section of the Canadian Pulp and Paper Association. In the spring of 1917 a meeting was held at Neenah, Wis., at which time the membership was 306. A feature paper was presented by S. Frank Shattuck of the Kimberly-Clark Corp. on "Safety and Social Service in the Industry." At the annual meeting held in February, 1918, the report of the Association War Service Committee by Frederic C. Clark showed the very valuable service of the Association to the industry.

Raymond S. Hatch

Raymond S. Hatch of the Hamersley Mfg. Co. was elected to the presidency in 1919 together with Robert B. Wolf, consulting engineer, New York, N. Y., who was elected vice-president.

Mr. Hatch has written as follows in regard to his administration:

"The membership in TAPPI was growing very rapidly following the end of the war in 1918 and I remember that during my administration, serious consideration was given to the idea of publishing our own journal. Tommy Keenan was then secretary of the Association and had been editor of the magazine *Paper* for several years. The activities of the Association had reached a point where Tommy could not devote sufficient time to Association affairs and at the same time act as editor of *Paper* as well as take care of other editorial duties imposed upon him by the publisher. The decision was reached, therefore, during my administration to employ him as full-time secretary of TAPPI.

H. P. Carruth
1917–1918

R. S. Hatch
1919–1920

"Up until 1920, the dues of TAPPI for active members had been $10. With the rapid growth of the Association and with the desire of its officers and Executive Committee to give more service to its members, the dues were raised in 1920 to $25 for active membership. The purpose of this increase was to give more service to members.

"*Technical Association Papers* was then in its third year and was a very modest publication. With the employment of a full-time secretary and with increasing funds available, it was planned to extend the service of the Association and make it more valuable to its members. Without doubt, this step, taken in 1920, was fully justified for the Association has been rendering increased valuable service to its membership since that time.

"It was during the period from 1918 to 1920 that the Committee on Vocational Education decided to publish the textbooks which today have become standard reference works of American pulp and paper manufacture. There is some contrast to glance over a TAPPI Year Book and compare the list of members with the list of members which was published in Series Three of *Technical Association Papers* in 1920. At that time, our membership was comparatively small and the necessity for a year book did not seem apparent.

"It was in the second year of my administration that the grade of Corporate Membership was established by the Association and the first corporate members were admitted to membership."

During Mr. Hatch's two terms, regional meetings were held in Buffalo, N. Y., and Saratoga Springs, N. Y. the annual meetings being held in New York City. During this period Witham's "Modern Pulp and Paper Making" and Sutermeister's "Chemistry of Pulp and Paper Making" appeared. The Association membership reached 577.

George E. Williamson

George E. Williamson of the Strathmore Paper Co.

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was elected president in 1921 and re-elected in 1922. Frederic C. Clark of the American Writing Paper Co. was elected vice-president.

Mr. Williamson commented on his terms as follows:

"The events of 1921–22 that stand out in my memory include the loss through resignation of Thomas J. Keenan who had been secretary-treasurer of the Association from the start. He was succeeded by William G. MacNaughton.

"A Service to Members Committee was organized and through it, two other committees that did excellent work. These were the Waste in Industry Committee, of which R. B. Wolf and George D. Bearce were chairmen and the Paper Drying Committee, headed by S. B. Jones of the Pejepscot Paper Co.

"We entered into a cooperative agreement with the *Paper Trade Journal*, wherein the latter established a TAPPI section to include the Association's publications, under the editorship of the secretary. All members were placed on the subscription list with the subcriptions paid for by the Association. I well remember the pleasant and fruitful conferences held at that time with Henry J. Berger, the editor."

Up to this time the Association office had been the same as that of the publication *Paper*. In 1922 it was moved to 18 E. 41st St., New York, N. Y., with the American Paper and Pulp Association. The annual dues were reduced from $25 to $15. During this period the textbooks on the manufacture of pulp and paper were published, a sum of $44,246 being raised by TAPPI and the Canadian Pulp and Paper Association for this purpose. The first Special Reports on Manufacturing Problems were issued during Mr. Williamson's terms.

Thomas J. Keenan

Since Mr. Keenan's secretaryship ended during Mr. Williamson's administration, it is well to pause here to note the fact. Mr. Keenan had been the editor of *Paper* and was elected secretary-treasurer when the Association was organized. Through the medium of his publication he was able to keep the industry well informed concerning the Association's activities. The Association grew rapidly and during Mr. Hatch's administration he found it necessary to give full time attention to the Association. He later became associated with the Exposition of Chemical Industries and *The Paper Industry*. He died in 1921 in Montclair, N. J.

Howard S. Taylor

Howard S. Taylor of the Management, Engineering, and Development Co. was elected president in 1923 and re-elected in 1924. With him Grellet N. Collins was elected vice-president.

Mr. Taylor commented as follows:

"New York with its meetings at the Waldorf of that day, its banquets at the Commodore, and the wholehearted support of W. G. MacNaughton, then secretary, and R. S. Kellogg, of the Newsprint Service Bureau, come to mind, along with committees, reports, and the eternal argument 'twixt those who sold and those who bought.

"TAPPI had gone over by 1923, well over, but there was much yet to be done with the relations of the technical man and the industry, to prove clearly his value in pulp and papermaking, and the industry's need of him from the source of raw materials to the finished roll or sheet.

"The years 1923–24 carried on this endeavor, and the Association made excellent gains in the interest of the mills throughout their different divisions of the

G. E. Williamson
1921–1922

H. S. Taylor
1923–1924

industry, and thereby gained in membership, both individual and corporate, in security of mind and treasury, and in the certainty of expansion of service to the industry in the days ahead, all of which has come to pass in high ratio under following administrations, and with the able guidance of R. G. Macdonald, present secretary.

"Would space permit, the names of many other associates, who were my friends and supporters through the 2-year period, could be mentioned, for they were many and legion. One here and there has gone on to where the sheet breaks no more, and to those who may read these lines I say, regards to you."

During Mr. Taylor's terms the Association published its first edition of "Paper Testing Methods." A great amount of attention was given to ways of eliminating waste in the industry. A paper-covered volume on "Standard Methods for Testing Materials" was issued. The membership was 584. A considerable amount of attention was given to mill apprenticeship programs.

George K. Spence

George K. Spence of the New York & Pennsylvania Co. was elected in 1925 and served two terms. E. C. Tucker of the Chemical Paper Manufacturing Co. was associated with him as vice-president.

Mr. Spence commented as follows:

"Corporate membership of the Association had decreased from 33 to 30 and the increase in other classes of members was practically at a standstill. Knowing the financial need of TAPPI we contacted all potential possibilities for corporate membership and procured 22 companies, increasing the number to 52. There was also an exceptionally large increase in other classes of membership.

"We changed the length of fall meetings from 2 to 3 days, allowing for discussion of papers and business sessions in the mornings and outside activities including mill visitations in the afternoons. This increased the interest in fall meetings, which had been very much on the decrease prior to this change.

"We arranged for publication and distribution o

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proceedings of the fall meetings, which included discussion of papers presented and we had published in bound form and sold to members the replies to the first 37 Special Reports, under the Service to Members Plan.

"A committee to study stream pollution problems

G. K. Spence
1925–1926

E. C. Tucker
1927–1928

was appointed and we arranged for cooperation with similar committees operating in the various states. These activities resulted in the final arrangement with American Paper & Pulp Association for the appointment of a National Stream Purification Committee, which held its first meeting in Chicago. This committee was active for a while, but was later replaced by the Stream Pollution Committee of A.P.P.A., which was succeeded by the National Council for Stream Improvement, an organization now very active in stream pollution problems.

"We formed new committees on Industrial Training for the Industry and Vocational Training in the Industry."

E. C. Tucker

E. C. Tucker of the Chemical Paper Manufacturing Co. was elected president in 1927 and served two terms. With him P. H. Glatfelter of the P. H. Glatfelter Co. was elected vice-president.

During Mr. Tucker's administration W. G. MacNaughton resigned as secretary-treasurer to become engineer for the News Print Service Bureau. He was replaced by R. G. Macdonald.

Three cloth-bound books were published: "Paper Testing Methods"; "A Bibliography of Papermaking Materials"; and "Chemistry of the Sulphite Process."

The Technical Association medal was first presented in 1928 at Wausau, Wis., to Ogden Minton of the Minton Vacuum Drier Corp. and to William Mason of the Masonite Corp.

W. G. MacNaughton

William G. MacNaughton, one of the founders of the Association, was secretary-treasurer from 1921 to 1927. Due to an automobile accident he was unable to take up his duties when elected and Thomas J. Burke, secretary of the Cost Association of the Paper Industry, was acting secretary for a few months. Mr. MacNaughton had been elected president, succeeding Harry Fletcher but found it necessary to resign when he went to the Inland Empire Paper Co. as manager. Mr. MacNaughton extended the activities of the Association to a considerable extent and turned over an excellent organization to his successor, R. G. Macdonald, in December, 1927.

P. H. Glatfelter

P. H. Glatfelter was elected president in 1929 and served one term. With him was M. A. Krimmel of the Hammermill Paper Co. as vice-president.

Mr. Glatfelter commented as follows:

"TAPPI, in the memorable year of 1929, can best be described, I believe, as suffering from growing pains. Above all it needed better organization, a larger membership, and more money to help a promising youth develop the full stature of a great association. One remedy for relieving the pains was found in establishing contributing memberships, now known as sustaining memberships. We were also fortunate in electing 194 new individual members and increasing the number residing in Europe.

"Toward better organization our Pacific Section, and first of our present sections was formed. For the first time a meeting was held below the Mason-Dixon Line, the fall meeting at Richmond, Va. This was the best attended meeting up to that time, which gave us reason to believe there was some virtue in the innovation.

"On the technical side an energetic program was carried out, including the publishing of West's Bibliography of Papermaking 1900–28. This is one of our best remembered contributions for it was the first time any such work had been done for the industry.

"We are also proud of another first when a $1000 fellowship was established at the Forest Products Laboratory, for the study of the relation of sheet properties to fiber properties through sheet structure.

"In subsequent years it has been a pleasure to see the growing pains being completely outgrown. TAPPI's contributions to the industry and to the use

P. H. Glatfelter
1929–1930

M. A. Krimmel
1930–1931

of paper everywhere are of indispensable and inestimable value, and I am sure the industry as a whole is proud of the men who have contributed so much of their time and energy in the growth of our Association. I sincerely hope that the same spirit of cooperation continues. The years ahead of us are uncertain, but there

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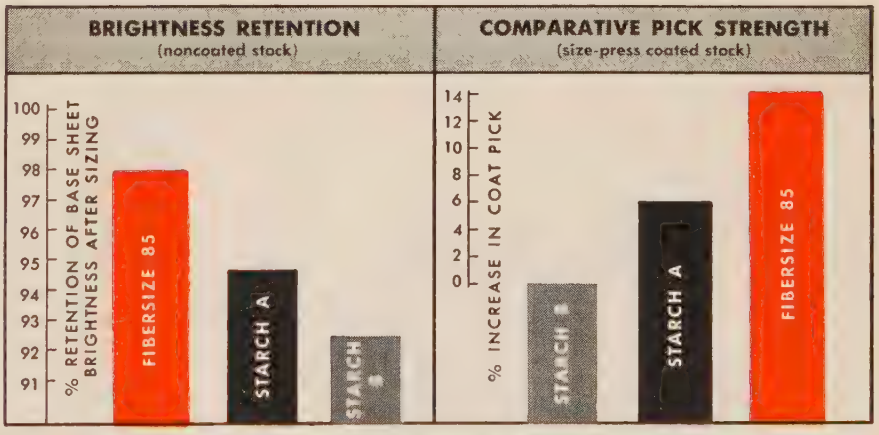

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will be many opportunities for the technical minds of our membership to develop ways and means for new and improved qualities and products."

During Mr. Glatfelter's administration the membership passed 1000.

M. A. Krimmel

Max A. Krimmel of the Hammermill Paper Co. was elected president in 1930 and served two terms. During this period Allen Abrams of the Marathon Paper Mills was vice-president.

A continuous series of Special Reports were issued from year to year, reaching 150 in 1931.

Mr. Krimmel devoted considerable time to the reorganization of the Association on a divisional basis. Under this arrangement the committees were grouped according to their general fields of interest. This type of organization still exists.

Although space does not permit, it is important to remember that the activities of the Association, particularly those of its growing number of committees, were expanding greatly and required a larger executive committee to assist in handling the numerous administrative details.

Membership increased to 1196 in 1931.

Three local sections were organized: the Lake States Section at Menasha, Wis.; the Kalamazoo Valley Section at Kalamazoo, Mich; and the Delaware Valley Section at Philadelphia, Pa.

The Association participated with a number of other organizations in the formation of the Inter-Society Color Council, an organization to study the technical problems related to color.

A research fellowship at the Forest Products Laboratory was financed.

Allen Abrams

Allen Abrams of the Marathon Paper Mills was elected president in 1932 and served two terms and C. C. Heritage of the Oxford paper Co. was elected vice-president.

Mr. Abrams comments as follows:

"With respect to the accomplishments during my administration as president of TAPPI, I would report as follows: at the time I took office an entirely new and comprehensive committee setup had been worked out by the previous administration under Max Krimmel. It, therefore, became necessary to define the duties of officers and committees; to establish standard methods, practices and specifications; finally, to set the whole organization into operation. The present-day system is based on work carried on during that period.

"During this administration the TAPPI Year Book and the TAPPI Standards were first issued. The TAPPI Council, an informal group, was put into operation in order to allow interested people an opportunity of discussing and helping to formulate the policies of the organization.

"There was a carefully planned procedure of improving the programs at our TAPPI meetings by securing papers of high quality and helping authors in the presentation of their papers.

"The finances of the Association came in for extended study, as the result of which certain procedures were installed, most of which are still in operation.

"As this administration was during the days of the NRA, considerable work was done in assisting the formulation of codes and of testing procedures to help make these codes effective."

In December, 1933, the offices of the Association were moved to 370 Lexington Ave., New York, N. Y., from 18 E. 41st St. The A.P.P.A. also moved.

Allen Abrams
1932–1933

C. C. Heritage
1934–1935

The number of Special Reports issued reached 205.

The New England Section was organized in 1933 at Holyoke, Mass.

In May, 1933, a cruise on the Savannah Line was enjoyed by about 100. This was for the purpose of inspecting the new laboratory of Charles H. Herty at Savannah.

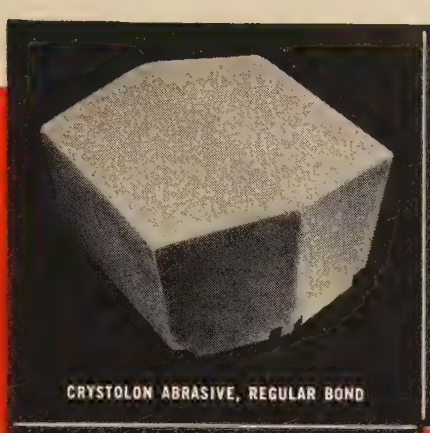
Clark C. Heritage

Clark C. Heritage of the Oxford Paper Co. was elected president in 1934 and served two terms. Grellet N. Collins of the International Paper Co. served with him as vice-president. During this period the Association headquarters were moved, with those of the A.P.P.A., to 122 E. 42nd St., New York, N. Y.

Mr. Heritage comments as follows:

"The years of 1934 to 1936 were those during which the industry was taking important steps toward improving business conditions after the bottom of the depression. Certain of these measures resulted in giving great impetus to technical matters, which in turn stimulated many of the activities of the Association. The major theme governing Association planning was expanded and improved service to the members and the industry. The committee organization was further perfected and strengthened, especially through more careful planning. A planning board of the vice-president and the seven divisional chairman was set up, development reports were published annually by the committee chairmen, project authorizations were initiated for committee work, and research grants were made available to the committee organization for cooperation with research and educational institutions to develop needed technical information, administered by a special committee on Educational Cooperation.

"The Manual of Standards issued in loose leaf form in 1933, was enlarged and widely distributed. The annual *Technical Association Papers* grew to a substantial cloth-bound volume. Revision of the textbooks on "The Manufacture of Pulp and Paper" was undertaken.



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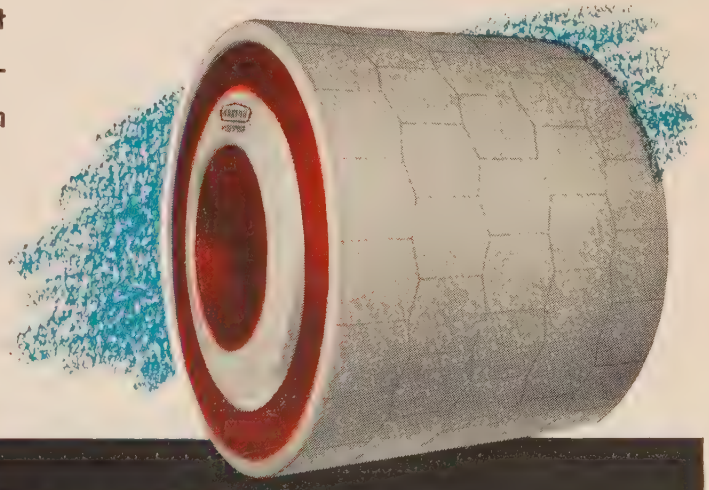

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"In 1934 the national fall meeting of the Association was held for the first time on the Pacific Coast, the Association being the guests of the Pacific Section. A special train carried Eastern members from Chicago to Portland, Ore. This meeting will always be remembered as one of the outstanding gatherings of the Association.

"The Ohio Section was chartered at Middletown, Ohio, in October, 1935, and a Northern New York group was organized which later became the Empire State Section."

Grellet N. Collins

Grellet N. Collins of the International Paper Co. was elected president in 1936 and served two terms. Associated with him as vice-president was William R. Maull of the Mead Corp.

During Mr. Collins' administration the membership reached 1521 individual members, 87 corporate members, and 91 contributing members. Special Reports Nos. 250 to 280 were issued in this period.

Two interesting summer or fall meetings were held, the first jointly with the Technical Section of the Canadian Pulp and Paper Association on a Saguenay cruise ship and the second at Savannah, Ga., the first meeting in the deep South, which was the best attended meeting to date aside from the annual meetings.

A collective Bibliography of Paper Making covering the years 1928–35 was published.

A fiber identification symposium and a microchemistry seminar were held at The Institute of Paper Chemistry in Appleton, Wis.

Beginning in 1938 the Bibliographies of Paper Making were published as separate cloth-bound volumes.

Frederic C. Clark

Frederic C. Clark, consulting engineer, was elected president in 1938 and served two terms. During his first term Harold R. Murdock of the Champion Paper and Fibre Co. was vice-president and in his second term W. H. Swanson of the Kimberly-Clark Corp. was vice-president.

During his administration the membership climbed to 1645 individual members.

The fall meetings were held at Green Bay, Wis., and Syracuse, N. Y.

A seminar on optical properties was held at The Institute of Paper Chemistry.

The Empire State Section received its charter in 1938.

In 1939 the TAPPI Data Sheets, in a loose-leaf binder, was issued. These are of particular value to engineers, chemists, and operating department heads.

A working fund of $3000 was appropriated to help The Institute of Paper Chemistry finance its Color Atlas of Fiber Identification and $5000 was contributed to the American Paper and Pulp Association to finance the publication of the book on "Definitions of Paper."

In his presidential address Mr. Clark stated:

"While TAPPI, by its growth, has lost in some respects it has in others made great gains. Today, our large meetings are like forums where new ideas are presented and discussed and where symposiums are held to discuss the various phases of a subject. These meetings have become much like past graduate seminars with informative material presented in lecture form, followed by a brief discussion period. The earlier meetings with their eight or ten papers have been replaced by 4-day conventions with their hundred or more papers, making it necessary to run several sessions

G. N. Collins
1936–1937

F. C. Clark
1938–1939

simultaneously. In the early days everyone knew considerable about each paper presented whereas today we must consider a multiplicity of subjects, covering every branch of science and manufacturing."

It is interesting to note that the first volume of *Technical Association Papers* published in 1918 contained 64 pages, the 1940 and 1941 volumes contain 752 pages, reflecting the growth in volume of meeting subjects mentioned by Mr. Clark.

Walter H. Swanson

W. H. Swanson of the Kimberly-Clark Corp. elected president in 1940 served two terms with Ralph A Hayward of the Kalamazoo Vegetable Parchment Co. as vice-president.

Mr. Swanson's administrations were marked by a more intensive development of the existing structure and activities of the Association.

In 1940 a fiber identification seminar was held at The Institute of Paper Chemistry.

For the second time a national fall meeting was held on the Pacific Coast, this time at Seattle, Wash.

The number of Special Reports issued has reached 318. The membership reached 1794.

Two interesting publications are in process of being edited, printed, and distributed. These are the translation of Loeschbrandt's "Bleaching of Sulphate Pulp" and the Association's first monograph on "Water for Industrial Purposes" prepared by the TAPPI Water Committee.

Mr. Swanson, as a contribution to the 25th anniversary résumé, outlined his viewpoint on the outlook for the future of the Technical Association as follows:

"Where should we go from here? That question is continually before the Technical Association and particularly its Executive Committee, which, after all, is a limited elected group from the active membership and, we hope, a true or typical cross section of this membership.

"Like any other association or any other enterprise, for that matter, the Technical Association at any particular time has a policy or program which it follows in

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the administration of its affairs. However, this program is not permanent in all details for all time. Certain features become fixtures which fit the nature of the Association's work and are only modified by being strengthened through changing specific functional parts which prove to be weak, unwieldy, or obsolete. Conversely other phases of the program become of less value and gradually disappear, new ones being substituted which are consistent with the changing times.

"In order to obtain an indication as to the probable future trend of the Association's work program, an examination of its nature and the evolving changes over the past years is helpful. To predict exactly what the future program will be is impossible and to recommend exactly what it should be would be facetious. But to indicate which trends appear to warrant more concerted effort in developing is perhaps not amiss.

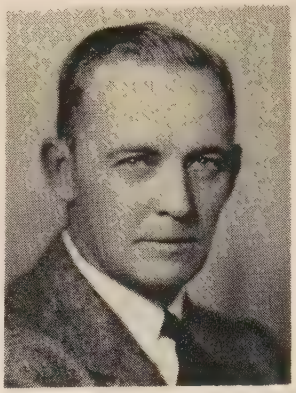
"Let us consider first the basic objectives which were sought by the founders of the Association. Primarily, it was desired to develop a medium or environment which would permit technical men of the pulp and paper industry to contribute to its basic fundamental or scientific knowledge underlying the various phases of the industry's manufacturing practices. Secondly, it was deemed very essential to set up machinery for converting this sometimes abstract knowledge into working tools such as testing procedures, manufacturing standards, product standards, and correct performance procedures for the several processes.

"Obviously, with objectives of the nature of the above the Association must of necessity be considered an educational society, democratic in nature, and not a learned society made up of intellectual giants trying to insulate themselves from the other functional groups in the industry.

"That the Association has maintained this educational viewpoint over the years since its inception is demonstrated by the character of its membership roll. We have the junior membership requiring limited training and experience in the industry on the part of the applicant; then there is the associate membership requiring a moderate amount of training and experience; and finally the active membership requiring extensive training and experience as qualifications. And in addition, the recent institution of affiliate membership has made available to those persons with no experience in an association with the industry, either directly or indirectly, the information which the Association disseminates to its membership.

"Basically this policy of education through distribution of technical information relating to the pulp and paper manufacturing processes and products, being the reason for existence of the Association needs no change. All that is required is that the Executive Committee bear in mind that the society is not limited in membership. It should be open to all that have a technical interest in the industry. However, careful exercise of the classification of memberships should always be in the minds of the committee. It must be realized that the machinery of the Association is operated by the active members solely and that this portion of the membership should be made up only of those who are fully qualified both by training and experience. If this is done, results will remain at their present high plane of quality.

"The Association's program originally centered around its meetings. It still does, but is supplemented by many added activities. We have now the committee structure which provides recognized channels for development of specific information for each phase of the industry's operations. There is the program of



W. H. Swanson
1940–1941

R. A. Hayward
1942–1943

fostering of local sections as a means for providing more frequent contacts between technical men within limited geographical areas. The research promotion program which entails financial support by the Association of certain research projects is in force. The publications program including such items as the *Technical Association Papers*, the Bibliography of Paper Making, the TAPPI Standards, the TAPPI Data Sheets, and the recently instituted project for fostering monographs by members on specific subjects is another important activity.

"Let us consider the above as the important functional features of the Association and see what the future holds in connection with them.

"First, with respect to the meetings, it can be assumed that there will be no major change in the character of the annual meeting. The only crying need here is a better physical environment and this will be provided next year. The fall meetings will probably follow the trend set by that held on the Pacific Coast last year and become more intensely educational in nature. The one being held at Ann Arbor this year demonstrates the trend markedly.

"The committee program will change only in that individual committees will probably tend toward a make-up involving a central group closely associated geographically to permit of more frequent personal contacts. This should work toward more effective committee output.

"The local sections program is receiving considerable attention by the Executive Committee at the present time. This can and should be one of the main activities fostered by the Association. Suffice it to say that some quite specific plans which are being developed will be laid before the Association in the near future.

"As concerns research promotion, the present program probably can be made more effective and beneficial to the individual members. It should receive major attention and definite action on the part of the Executive Committee.

"The monograph phase of the publication's program

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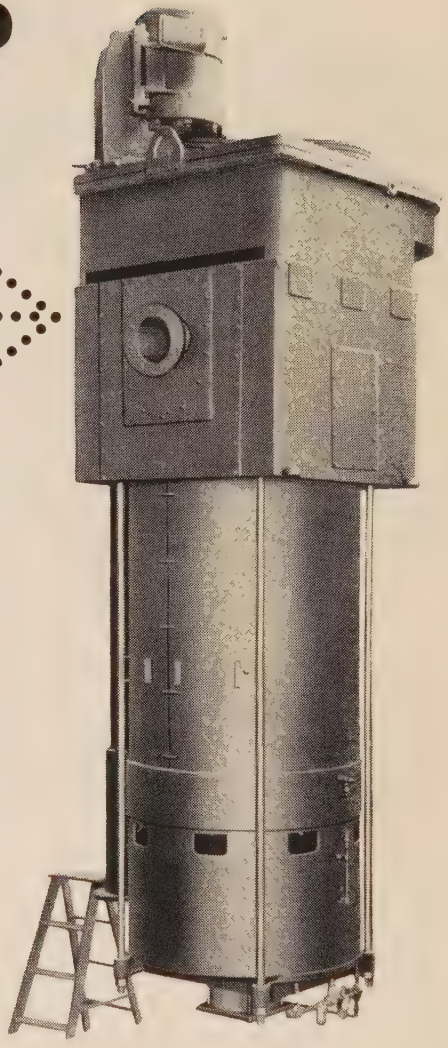

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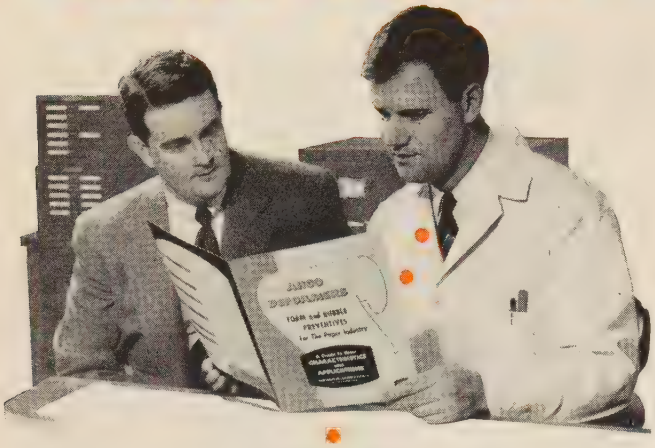

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is an attractive field to explore and develop. There is developing within the membership of the Association a group of technicians who may be considered competent authorities in every phase of the industry's structure. It certainly would be to the advantage of the industry to have these men make their knowledge available in the form of monographs, financed by the Association. This program now started should be actively supported.

"Considered over all, then, there does not appear to be a necessity for any startling changes in the nature of the Association's policy program. The evolutionary changes indicated will develop as a matter of course and are sound in principle."

Ralph A. Hayward

Ralph A. Hayward, president of the Kalamazoo Vegetable Parchment Co., served as president of the Association for two terms from 1942 to 1944 with Vance P. Edwardes, sulphite superintendent, International Paper Co., Palmer, N. Y., serving as vice-president.

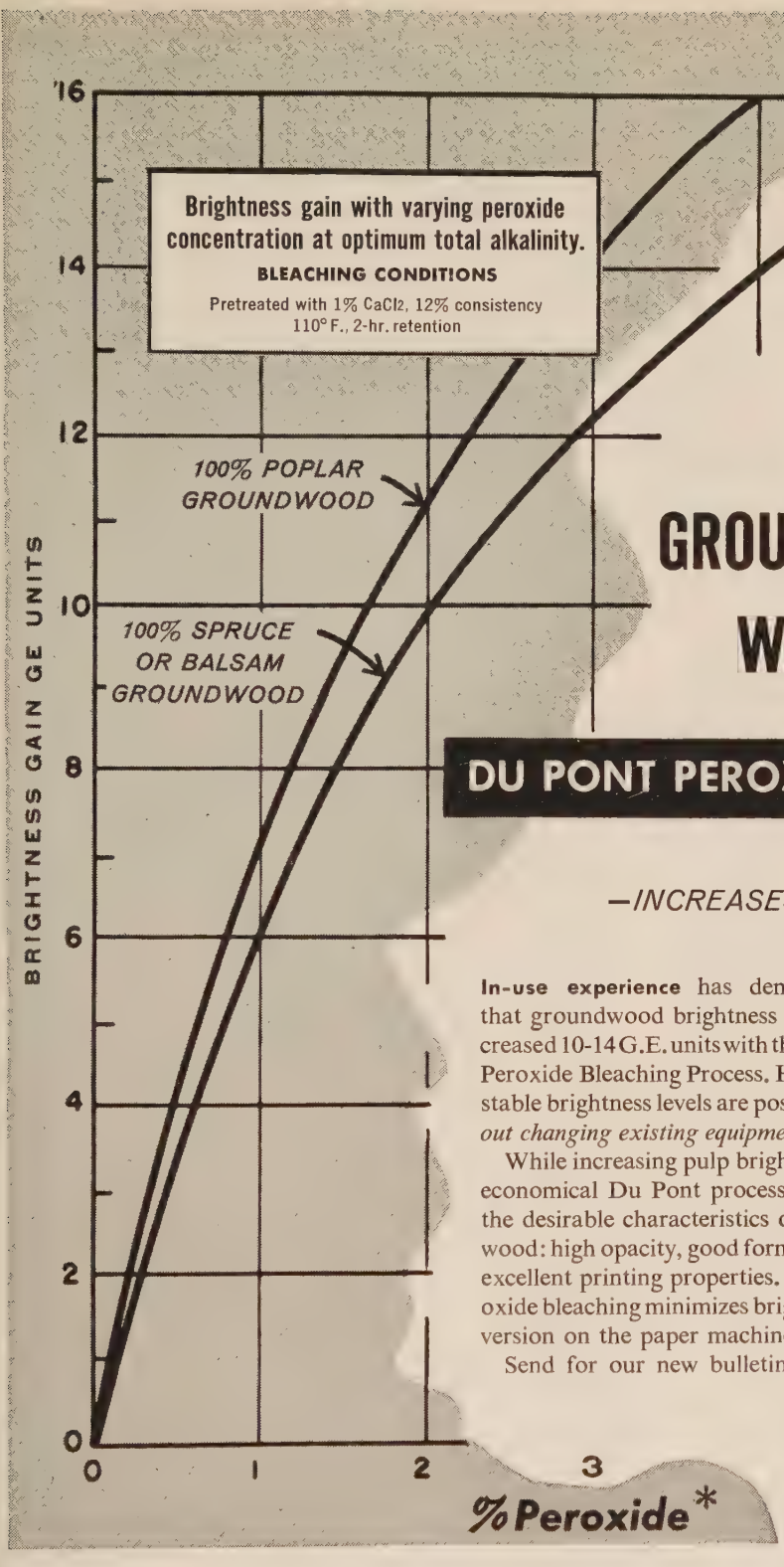
Since many members of the Association held Officers Reserve Corps commissions it became necessary for them to enter the armed services. Some resigned their membership, while others continued. Many others joined various branches of the service or entered other industries for the duration. At the same time the great responsibility of the industry to produce products to replace more critical materials led to a large influx of new members from industries that convert paper and use it for packaging purposes.

By the end of 1943 the total individual membership has reached 1926 with 125 corporate members and 110 sustaining members.

The 1942 fall meeting of the Association was held in the Statler Hotel, Boston, Mass. There were about 1000 in attendance, a number much larger than expected. The large attendance was evidently due to the great wave of interest in packaging and new paper products to meet the growing shortages of other materials. An unusually large number of nonmembers were present and also reflected the severity of the war problems. Norman F. Bearse of the Champion-International Co. was general chairman and was assisted by an enthusiastic and capable convention committee. A feature of the convention was an exhibit of wartime paper products which occupied the entire mezzanine of the Statler. It was of great value as an indication of the trends in container construction and was highly colorful as paper exhibits usually are.

The 1943 fall meeting of the Association was held at the Palmer House, Chicago, Ill., Sept. 21–24, 1943. More than 4000 registered either for the meeting or the exhibit. The meeting was designated as the Army and Navy Requirements Conference, and was featured by a magnificent 10,000 sq. ft. exhibit built by the War Department and demonstrating the many uses of paper purchased through all the procurement agencies of the Army, Navy, and Marine Corps.

A large contingent of military and naval officers were on hand to explain the use requirements of the papers and containers used and required. The technical program was devoted largely to Army and Navy paper problems. The meeting was the greatest and



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most successful effort, during the war, of bringing together all of the important interests concerned with the use of paper in the war effort. A. E. Montgomery of the J. O. Ross Engineering Co. was general chairman of the meeting. The papers presented were published widely in trade magazines and thereby greatly extended the influence of this tremendous meeting.

No new sections were formed during these years although a new organization called the Professional Paper Group of Chicago was organized in December, 1943. This organization was a natural product of the fall meeting of the national body held in September. The attendance at the first meeting was about 140, including many converters and paper salesman.

A feature of some of the section meetings during 1943 was a regional arrangement in which meetings were held frequently in various parts of the territory normally served by the Section. This resulted in a reduction of member travel. In the Empire State Section, in particular, this plan was successful with meetings at Glens Falls, Syracuse, and Watertown, and in the New England Section with meetings at Boston, Springfield, Holyoke, and Pittsfield. The Pacific Section had followed this plan for several years. It is possible that this success may lead to the formation of other sections serving more restricted areas than at present. The sections existing in 1943 were the Pacific, Kalamazoo Valley, Lake States, Ohio, New England, Empire State, and Delaware Valley. Another organization, called the Maine-New Hampshire Group, held meetings during the few years past.

In respect to the publications of the Association, *Technical Association Papers*, the TAPPI Year Book, Bibliography of Papermaking and U. S. Patents, TAPPI Standards, TAPPI Data Sheets, and Special Reports (321–336) were issued without interruption. The second of the TAPPI Monographs "Saving of Fourdrinier Wires" was issued in 1942, being prepared for the Association by J. E. Goodwillie of the Beloit Iron Works. This monograph was another contribution to the war conservation program.

As a further assistance to the war effort two other publications were distributed: the first "Paper—The Lifeblood of Civilization" an attractive, illustrated booklet showing the importance of the paper industry; and the *TAPPI Bulletin*, the first number of which was published in November, 1942. This publication (4–8 pages) appeared about twice a month since its inception. This was essentially a war service to assist the industry and its customers meet the gigantic problems derived from the war requirements. The main problems consisted of the development of new containers and packaging materials required by the armed forces and by civilians to replace such critical materials as metals, rubber, etc. In addition to sending these to all members they were made accessible to a large number of paper converters and packagers. They included feature articles describing wartime paper and container industry activities, new testing methods, new paper packages clearing house, specifications and abstracts of trade paper literature relating to packaging. Other feature subjects of immediate application were also covered.

The major activities of the Association were directed toward the solution of wartime problems.

Early in 1942 the secretary endeavored to raise a fund to help finance the study of packaging of dehydrated foods being carried on at the New York Agricultural Experiment Station at Geneva, N. Y.

The Staff of the Association did considerable work for the War Production Board in obtaining information of immediate value to the Machine Shop War Production Board.

The Staff also assisted the American Paper and Pulp Association War Conservation of Materials Service by preparing a number of bulletins to show how the life of equipment and materials could be extended by care and by substitution.

In June of 1942 the secretary organized a meeting at the Stevens Hotel in Chicago to assist Major Charles Herman and the Subsistence Research Laboratory of the Chicago Quartermaster Depot in establishing means of evaluating the new paper ration containers. About 175 attended this meeting and constituted a remarkable cross section of all of the interests needed to do this important job.

The secretary cooperated with the "Bridgebuilders," a group that broadcast on shortwave radio of the British Broadcasting Co., and sponsored by the Papermakers Association of Great Britain and Ireland to encourage correspondence between British and American papermakers throughout the war period.

To assist the War Production Board establish a basis for limiting chlorine consumption the Association developed a standard procedure for measuring the brightness of pulp and paper. Members of the Association gave considerable time to this and other W.P.B. activities.

At the end of Mr. Hayworth's term of office a recommendation was made and passed that the objectives that were stated in his presidents' address be continued. In response Mr. Hayward stated:

"If, in an effort to confine my time to the formal reading of my report, I have in any sense dwarfed my enthusiasm for what this group can accomplish, I wish to re-emphasize it again. This industry is just in its infancy as far as the service it can render. The possibilities of new products, of improving the products that we now make, and of extending our market are beyond our comprehension. We do not know what the end of this war is going to be, but you can put down one conclusion which you can be sure will be accomplished, and that is a great awakening in the great countries of the world that have been very backward in the past. There is going to be a new China, and the standards of living for millions upon millions of people are going to move forward in the next 10 years probably more than they have moved forward in the past century or two.

"There is one further conclusion that you can make and that is that the standard of living is directly proportional to the use of paper. You can measure the standard of living in any country or in any organized territory by the amount of paper that people consume. It is the only means by which their standard of living can be increased. When you visualize the increase in the use of paper and paper products that will be required to bring about this improvement in the standard of

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living throughout the world, you can realize that the opportunities for our industry are greater than those facing any other industry that exists. The only thing we have to do is to make use of these opportunities to the best advantage. I am looking forward not only to the growth of the industry but also to the Association leading in that growth."

Vance P. Edwardes

Vance P. Edwardes of the International Paper Co. served two terms from 1944 to 1946 with Gunnar W. E. Nicholson of the Union Bag & Paper Corp. serving as vice-president.

The membership increased to 2288 individual members, 148 corporate members, and 140 sustaining members. The members, who were transferred to the inactive list as a result of entering the various branches in the armed services, continued to increase during the 1944–46 period, and their names were listed in the TAPPI Year Books issued during these years.

Although it was not publicized, it was the intention to hold the 1944 fall meeting again in Chicago. Transportation and hotel difficulties caused a number of members to recommend that no meeting be held. This proposal was submitted to the membership for vote and with nearly the unanimous consent of the members voting, this prospective meeting was cancelled.

A number of the Association's committees took advantage of this situation and held meetings to discuss their own projects. The Pulp Purification Committee met at Buffalo, N. Y., on Oct. 13, 1944, during the convention of the Electrochemical Society. The Alkaline Pulping and the By-products Committees met jointly at the De Soto Hotel, Savannah, Ga., on Oct. 18–20, 1944. More than 100 attended and discussed a number of technical papers and subjects. The success of this meeting was largely due to the efforts of G. W. E. Nicholson, K. G. Chesley, R. H. Stevens, and Kirk Sutlive. A feature of the meeting was a visit to the mill of the Union Bag & Paper Corp. in Savannah.

Because of war conditions, the Association was obliged to cancel its 1945 Annual Meeting but the Executive Committee did meet to carry on the affairs of the Association. At this meeting, the papers scheduled for presentation at the convention were presented by title, and on Monday, February 19, the Executive Committee gave a luncheon at the Hotel Commodore, to which members in the New York area were invited. Following the luncheon the TAPPI Medal was presented to B. W. Scribner by J. d'A. Clark. The 31st Annual Meeting was held Feb. 25–28, 1946, at the Hotel Commodore, the first to be held after World War II.

The Maine-New Hampshire Section received its charter in 1944. All sections continued to hold regional meetings although they were handicapped by travel conditions. The Empire State Section met this situation successfully by establishing four chapters that met frequently at Glens Falls, Fulton, Watertown, and Niagara Falls, N. Y. The Pacific and New England Sections met this problem by holding meetings at various locations in the territory that they serve.

Like other technical societies, the Technical Association was frequently called upon to assist the various agencies of the Army, Navy, and other branches of the Government.

In the *TAPPI Bulletin*, already mentioned, the Association kept the industry up to date regarding currently issued procurement specifications.

The Association assisted the War Prisoners' Aid

V. P. Edwardes
1944–1945

G. W. E. Nicholson
1946–1947

(Y.M.C.A.) in obtaining copies of papermaking texts, especially old issues of the Manufacture of Pulp and Paper for use of American prisoners in German internment camps.

On Nov. 3, 1944, representatives of TAPPI and the ASTM met with representatives of the Army, Navy, War Production Board, and other Government agencies to decide what testing methods did not exist and were most urgently needed in connection with the preparation of specifications and to decide how they should be brought into being. A special task committee of the Technical Association was organized to proceed with this work and individuals were assigned to work on each of the methods most urgently needed. This work proceeded under the general direction of Major James d'A. Clark, Chicago Quartermaster Depot, chairman of the TAPPI Testing Division; W. H. Graebner, Marathon Corp., chairman of the Packaging Materials Testing Committee; Don L. Quinn, chairman of the Container Testing Committee, and B. W. Scribner, National Bureau of Standards, chairman of the Paper Testing Committee. These committees worked closely and satisfactorily with the Army Packaging Board, the Navy, and the Container Coordinating Committee of the War Production Board.

A special task committee, under the chairmanship of Peter J. Massey of the H. P. Smith Paper Co. cooperated with a committee of the Society of Automotive Engineers in developing paper specifications and tests for special wrapping papers for antifriction bearings. This work was of particular value to the Office of the Chief of Ordnance and the Army Air Forces.

During 1944 the Association responded to requests from such organizations as the Chicago Quartermaster Depot, San Diego Naval Air Station, Minneapolis Area AAF, Office of the Chief of Engineers, Production and Engineering Section AAF, Curtiss-Wright Corp. Propeller Division AAF, Wichita, Kan., Midwestern Procurement Districts, Jeffersonville (Ind.) Quartermaster Depot, Edgwood Arsenal CWS, Quartermaster

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In recognition for its services to the war effort, the Association was awarded the Navy's Certificate of Achievement.

Although wartime printing difficulties prevented the publication of any additional monographs, the yearly editions of *Technical Association Papers*, TAPPI Year Book, the bibliography, the *TAPPI Bulletin*, as well as the TAPPI Standards, TAPPI Data Sheets, and Special Reports (837–362) were issued. The *TAPPI Bulletin*, in particular, was of special service in that it continued to keep the membership up to date on recent developments and the various Government and packaging specifications.

G. W. E. Nicholson

G. W. E. Nicholson served as president for only one term, 1946–47, being obliged to retire from the presidency because of his increased responsibilities with the Union Bag & Paper Corp. Worthen E. Brawn of the Pejepscot Paper Co. was vice-president.

In his address to the Association, Mr. Nicholson said in part:

"We are today meeting after having passed through the first postwar year with its many adjustments for the industry, as well as for the members of our Association. It has been a very active year and our organization has grown still further with an increase of about 600 members. A great number of members have returned from the armed forces to civilian life.

"Committee work has been further extended during the year through over 60 committees, and undoubtedly the coordination brought about by appointing executive committee members as general chairmen of various divisions which was instituted about three years ago, has been helpful in bringing about excellent results. The Association owes a great deal to the great number of members who are willing to serve and assume assignments at great personal sacrifice. The top management in the industry has taken a still greater interest in our work and has given us splendid support by encouraging their technical men to actively participate in the various activities of the Association."

As Mr. Nicholson mentioned, the membership increased about 600, there being 2768 individual members, 172 corporate members, and 158 sustaining members at the end of 1946.

The difficulty in obtaining adequate hotel accommodations gave the Association an opportunity to experiment with a new convention service, namely, that of conducting three fall meetings of specialized interest that were attractive to certain specialists. Although the scope of each meeting was limited, there was as much time devoted to each as would normally have been devoted to a general fall meeting.

On Sept. 25–27, 1946, a conference was held at the Statler Hotel and the Rackham Memorial Educational Building in Detroit, Mich., devoted to a thorough survey of the pulpwood stands inventory and consideration of their prospects for utilization. This meeting was attractive to company management and foresters. About 250 attended. Harry F. Lewis of The Institute of Paper Chemistry organized the program. The importance of the information brought together for presentation was considered great enough to justify the publication of a monograph containing the data presented.

On Oct. 2–4, 1946, the Association conducted its first engineering conference which was held at the Pfister Hotel, Milwaukee, Wis. Although this meeting, like the others, was open to all interested, a special effort was made through invitation to mill management to have mill power, maintenance, and construction engineers attend. This resulted in an unusually fine attendance of about 250 plant engineers who represented a major part of the industry's production. An excellent program was provided by the Association's Engineering Division, E. F. Burns, International Paper Co., chairman. A fine program of industrial plant visits was provided by the Hummel & Downing Co., Allis-Chalmers Mfg. Co., and the Beloit Iron Works. R. K. Prince of the Allis-Chalmers Mfg. Co., tendered useful services as chairman of the local committee.

On Oct. 14–16, 1946, the Alkaline Pulping and Chemical Products Committees sponsored a meeting at the Roosevelt Hotel, New Orleans, La. About 250 attended. W. F. Gillespie, Gaylord Container Corp., K. G. Chesley, Crosset Lumber Co., and R. H. Stevens, National Container Corp., and their committeemen organized the program. The Gaylord Container Corp., Bogalusa, La., Vertrees Young, vice-president, acted as host and extended fine courtesies, including a visit to the mill and its woodlands. This was the second conference sponsored by these two committees, the first being held in Savannah in 1944. The value of these special conferences was evident in the number of men, particularly in the operating departments of the mills who were able to attend and who would probably have been unable to attend a more general conference in a less convenient location.

On April 26, 1947, the Fibrous Agricultural Residues Committee conducted a conference at the Northern Regional Research Laboratory at Peoria, Ill. S. I. Aronovsky, chairman of the committee, organized and presided over the program. About 50 attended. This was the second conference sponsored by this committee at Peoria. Since this committee served the strawboard mills of the middle west the conference was particularly valuable in providing for the convenience of those served by it. Nearly all companies utilizing straw were represented, in some cases by their executives. The committee through its conferences rendered a much needed technical service to a branch of the industry that has problems dissimilar in many respects to other branches of the industry.

A charter was granted in the fall of 1946 to the TAPPI Chicago Section which was formerly known as the Chicago Professional Paper Group. This organization had an unusually successful career due to the enthusiasm supplied by a large group of leaders. All of the

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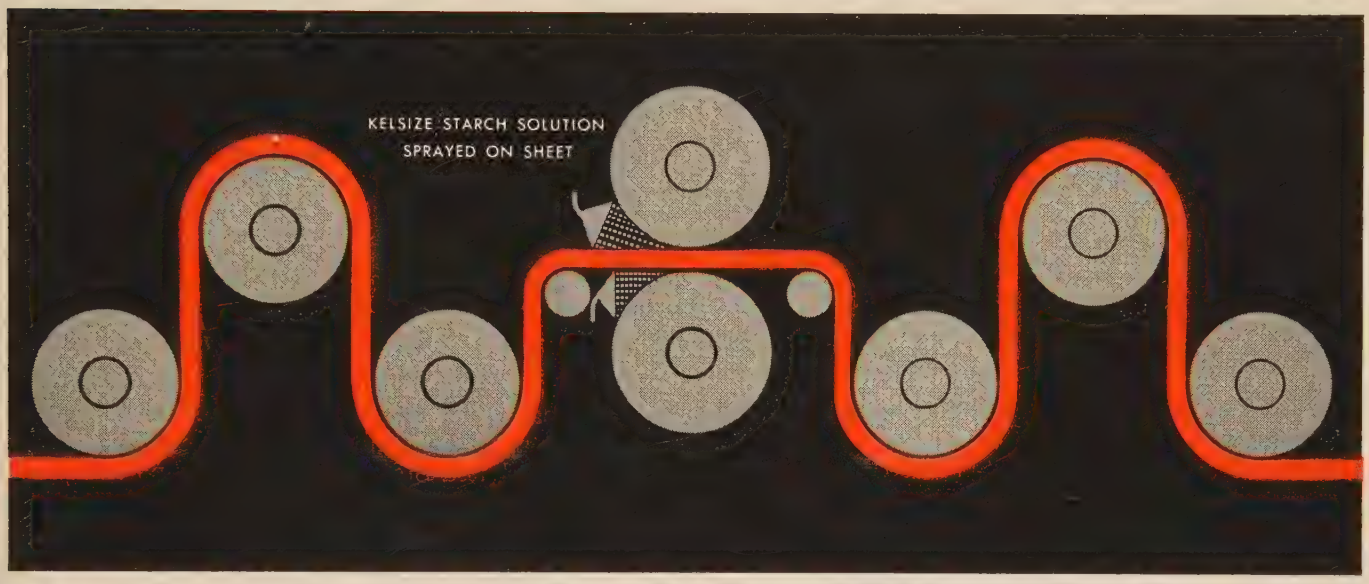

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sections returned to peacetime routine and held meetings on a regular periodical basis. The revival of activities by the Ohio Section was noteworthy. This section was particularly successful in arranging a series of meetings of a roundtable nature in which a large proportion of its membership participated. The Pacific Section carried on a series of regional meetings that started in midafternoon and continued with a dinner and afterdinner speaker. The final meeting held at Gearhart, Ore., was attended by a very large group and featured the presentation of its now famous Shibley Award for the presentation of a superior paper by one of its younger members. The Empire State, New England, Maine-New Hampshire, Lake States, Kalamazoo Valley, and Delaware Valley Sections all had fine progress throughout the year.

One monograph "Starch for Paper Coating" was issued at the close of the year and one on Pulpwood; Stands, Procurements and Wood Utilization neared completion. The one on starch, Monograph No. 3, was the first of a series prepared by the TAPPI Coating Committee under the chairmanship of Werner Kaufmann of Kupfer Bros. Co. It represented an unusually fine cooperative effort on the part of the paper coating mills and the starch manufacturers, the latter under the energetic leadership of J. G. Bullard of the Corn Products Refining Co. Chapters were written by highly qualified individuals and the entire material was critically reviewed by technical and operating men of most of the coating mills.

The Bibliography of Papermaking and U. S. Patents issued annually was not published in 1946. Instead an effort was made by C. J. West of The Institute of Paper Chemistry to prepare a collective bibliography covering the years 1936–45. The preparation of the collective bibliography represented a tremendous effort on the part of Mr. West and required more time than was originally anticipated. Printing plant difficulties also accounted for delay in publishing. As a result this volume was delayed beyond the end of 1946. As a permanent record its value cannot be measured. The Association was indeed fortunate in having the interest and industry of Mr. West in doing this important work.

The regular publications of the Association were issued throughout the year.

Worthen E. Brawn

Worthen E. Brawn assumed the presidency of the association in February, 1947, with W. F. Gillespie, technical director of the Gaylord Container Corp., Bogalusa, La., as vice-president.

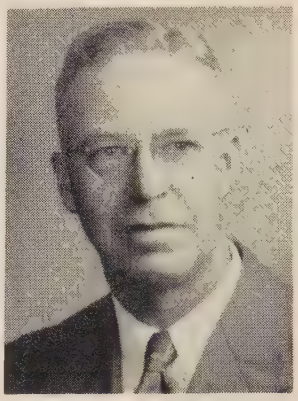
On July 17, 1947, as Mr. Brawn was en route to Europe where he intended to visit the various papermaking centers, he suddenly passed away of a heart attack. He was one of the first American papermakers to have a technical education.

W. F. Gillespie

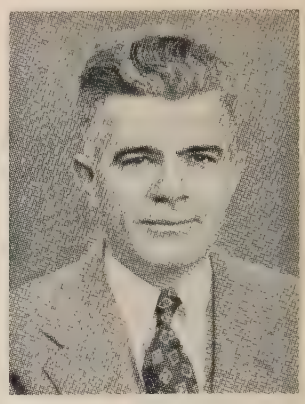
On the death of W. E. Brawn, W. F. Gillespie of the Gaylord Container Corp. assumed the presidency of the Association and W. R. Barber of the Crown Zellerbach Corp. was appointed vice-president by the Executive Committee. Mr. Gillespie was re-elected in 1948 and A. E. Bachmann, Missisquoi Corp., became vice-president.

Following the pattern of 1946, the membership continued to grow at a rapid rate reaching 3557 individual members, 205 corporate members, and 176 sustaining members by Dec. 31, 1948.

During 1947 the Association Technique de l'Industrie Papetiere was organized in France. This organization



W. E. Brawn
1947



W. F. Gillespie
1947–1948

which is patterned after the Technical Association was organized after a number of French papermakers visited the United States and had an opportunity to investigate the organization and its activities in this country.

A similar organization was formed by the representatives of the industry in Australia.

Under the leadership of Harold R. Murdock, a former officer of the Technical Association, the Technical Association of the Pulp and Paper Industry of Japan was organized in February, 1947, in Tokyo. This is the first organization of its kind organized in the Japanese paper industry.

For a second year the Association followed the policy of holding a number of fall meetings devoted to limited but important interests. Prior to the war it was the practice to hold a general fall meeting.

The first fall meeting was held at Appleton, Wis., on Sept. 3–5, 1947, and was sponsored by the Fundamental Research Committee. It was devoted to a consideration of the polysaccharides and lignin. Harry F. Lewis of The Institute of Paper Chemistry was general chairman.

The second meeting was held at Syracuse, N. Y., on Sept. 25–26, 1947. It was sponsored by the Plastics Committee. E. C. Jahn of the New York State College of Forestry was general chairman.

The third meeting was held at Asheville, N. C., on Oct. 9–11, 1947. This meeting was sponsored by the Alkaline Pulping and Chemical Products Committee and was held jointly with the Southern and Southeastern Division of the Superintendents Association. Visits to the mills of the Champion Paper & Fibre Corp., Canton, N. C., and the Ecusta Paper Co., Pisgah Forest, N. C., featured this meeting. K. G. Chesley of the Crossett Lumber Co., Crossett, Ark., and W. P. Lawrence of the Champion Paper & Fibre Co. were chairmen respectively of the TAPPI sponsoring committees.

The fourth meeting was held at Alton, Ill., on Oct. 23–24, 1947, and was sponsored by the Fibrous Agri-

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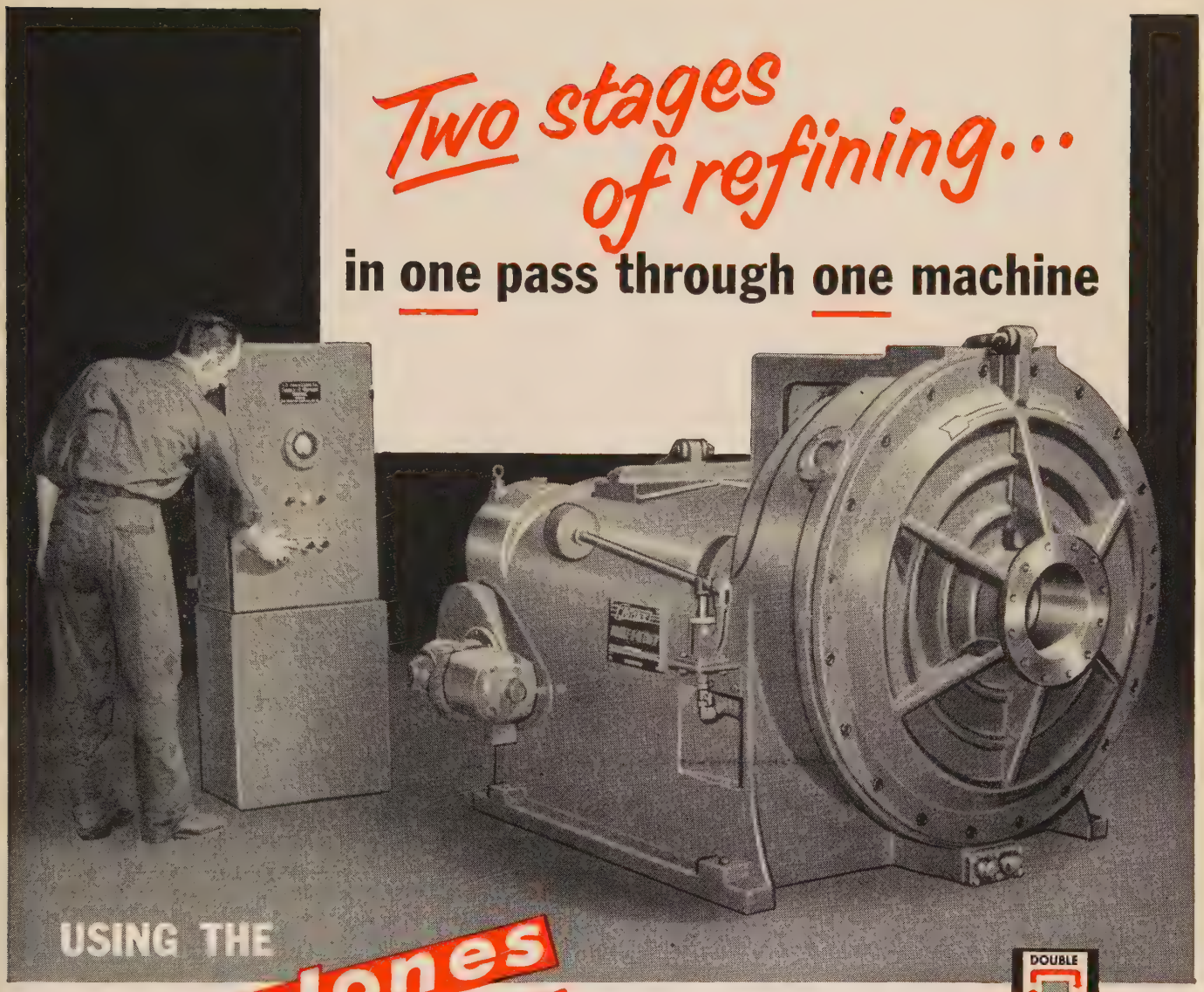

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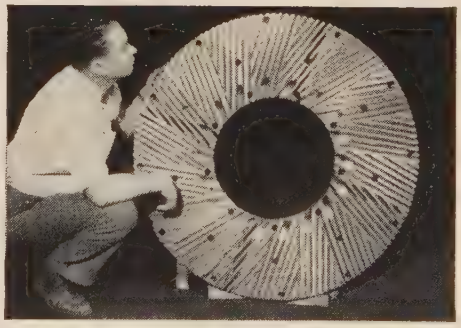

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cultural Residues Committee. S. I. Aronovsky of the Northern Regional Research Laboratory, Peoria, Ill., was general chairman. The sessions were held in the mill of the Alton Box Board Co. who was the host to the group.

The fifth meeting was held at the Bellevue Stratford Hotel, Philadelphia, Pa., on Nov. 3–5, 1947, and was designated as the Second Engineering Conference of the Pulp and Paper Industry. This meeting was sponsored by the Engineering Division and J. W. Hemphill of the Johns-Manville Sales Corp. was general chairman. The meeting was featured by visits to the plants of the Pusey & Jones Corp. and J. E. Rhoads & Sons in Wilmington, Del., and to the Downingtown Mfg. Co. in Downingtown, Pa., the Westinghouse Electric Co. and Brown Instrument Co. in Philadelphia, Pa.

All of the meetings held were very successful and brought together individuals having particular interest in the subjects featured. The total attendance of the five meetings was probably greater than it would have been if a single fall meeting had been held.

Because of the success of the functional fall meetings, this policy was continued in 1948. In August, the Plastics Committee sponsored a Plastics Conference and the Fundamental Research Committee a program devoted to the theme "The Physical Properties and Components of Wood," at The Institute of Paper Chemistry, Appleton, Wis.

A Mechanical Pulping Conference in cooperation with the Technical Section of CPPA was held in Poland Spring, Me., in September, 1948, and a Testing Conference at the Mellon Institute, Pittsburgh, Pa., in October. The Third Engineering Conference was held in Buffalo, N. Y., and the Fibrous Agricultural Residues Conference in Peoria, Ill. All of these meetings were characterized by excellent programs and attendances.

No new local sections were established during 1948 although the Empire State Section established a branch in June known as the Metropolitan Group which meets monthly in New York City at the famous Fraunces Tavern. The Pacific Section again sponsored an outstanding seminar on fundamental wood chemistry, during which Mr. and Mrs. Holger Erdtman of Stockholm, Sweden, lectured. The Maine–New Hampshire Section sponsored the Mechanical Pulping Conference of TAPPI and the CPPA Technical Section at Poland Spring, Me. All sections returned to their normal schedule of meetings and had successful seasons.

Although the publication practice of the Association followed the pattern of recent years definite plans were made to change some of these, beginning in 1949.

Series 31 of *Technical Association Papers* was the last volume to be printed. Since 1921, the meeting papers of the Association were published in the *Paper Trade Journal*, a weekly magazine owned by the Lockwood Trade Journal Co. At the end of each year these papers were collated and printed, together with considerable additional material in a cloth-bound volume called *Technical Association Papers*.

The establishment of the new magazine to be called *Tappi* and the discontinuation of the use of space in the *Paper Trade Journal* was decided upon after discussions of the subject over several years. The former arrangement was mutually advantageous but there was a growing feeling that the Association could serve its members and the pulp, paper, and paperboard industries better by issuing its own magazine.

One of the results of the Association's new publishing policy was the termination of the *TAPPI Bulletin*. This publication was started as a wartime service and performed its job valiantly. Ninety issues were published since 1942 and although it cannot be credited with winning the war it did much to coordinate the efforts of the industry and its grandchild, the packaging industry, in helping to do so.

One monograph "Pulpwood Stands, Procurement and Utilization" was issued. The material contained in this monograph was the group of papers and their discussions presented at the Detroit, Mich., meeting of the Fundamental Research Committee in the fall of 1946. There was a definite need for such a publication and its reception was rather enthusiastic.

Two monographs were issued in 1948.

Monograph No. 6 "Nature of the Chemical Components of Wood" was sponsored by the TAPPI Fundamental Research Committee and consists of the presentations made at the Appleton Conference in 1947 which was organized, in part, to provide the material for this book. To Harry F. Lewis, and his colleagues, the Association owes a debt of appreciation for bringing this masterpiece of technical literature to fruition.

Monograph No. 7 "Pigments for Paper Coating" was prepared by the subcommittee on pigments, of which William R. Willets of the Titanium Pigment Co. was chairman. This is one in a series of monographs prepared by the TAPPI Coating Committee under the chairmanship of Werner Kaufmann, Kupfer Bros. Co. They represent a tremendous amount of voluntary effort on the part of a large number of individuals.

During this period Data Sheets, TAPPI Standards, and Special Reports from 370 to 385 were issued.

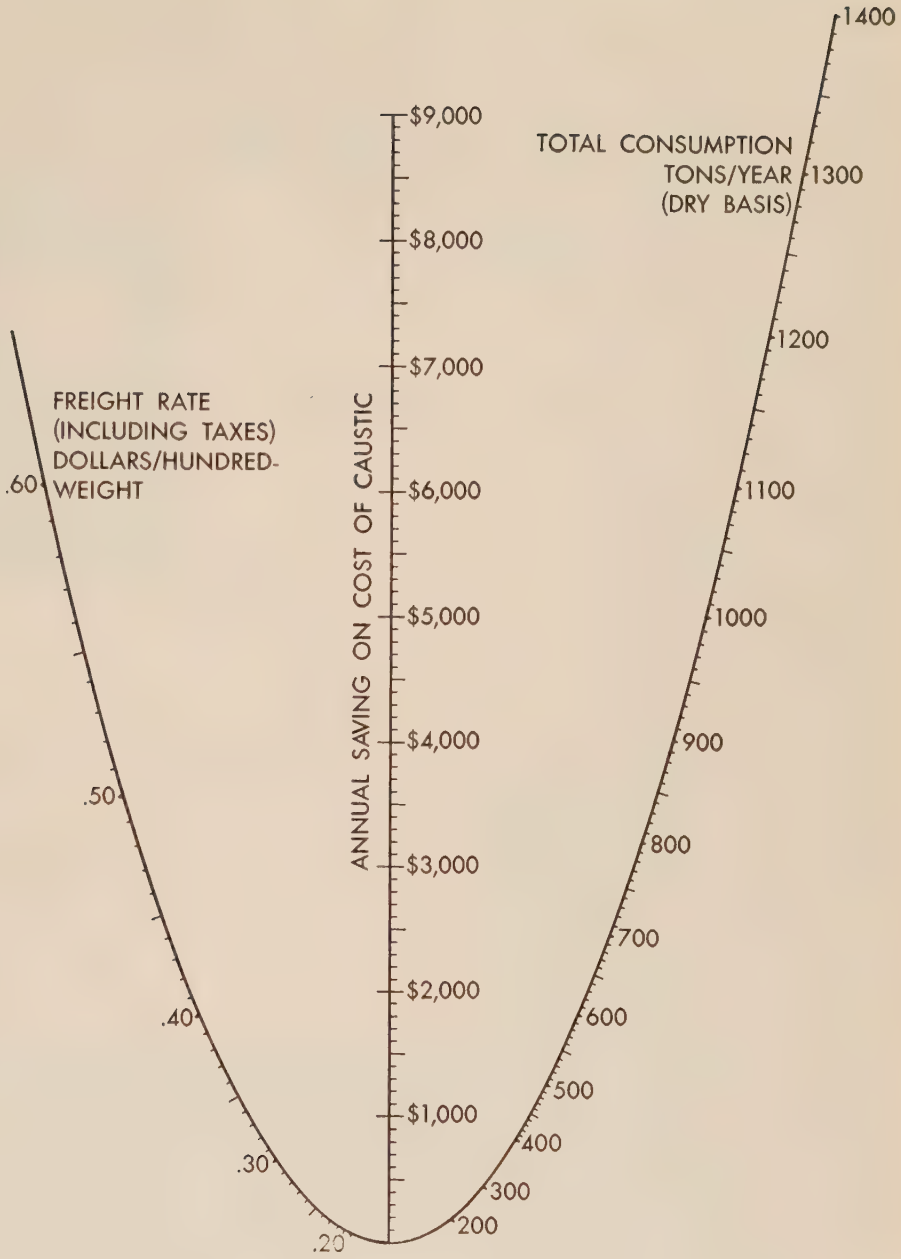
The major technical work of the Association was carried on by more than 70 committees in seven divisions.

A. E. Bachmann

Albert E. Bachmann, vice-president of the Missisquoi Corp., was president of the Association from 1949–50 with K. P. Geohegan of the Howard Paper Mills, Inc. as vice-president.

On Dec. 31, 1950, the individual membership reached 4268 with 220 corporate and 190 sustaining memberships. In his 1949 president's address, Mr. Bachmann pointed out, "Membership in TAPPI implies a responsibility on the part of its entire membership to take an active part in some phase of its activities so that all can benefit from the work and experience of each other." He then went on to plead for more participation in TAPPI committee work.

Previous general fall meetings were held at Pacific Coast locations in 1934 and 1940. In 1949 the Pacific Section sponsored a general fall meeting which was held at the Multnomah Hotel in Portland, Ore., on Sept. 11–15, 1949. This was one of the best organized conventions ever held by the Association. More than 700 attended, including about 250 from eastern points. A special train of the Union Pacific Railway carried about 125 from New York and Chicago to Portland.



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Featured at this meeting was a visit to the woodlands of the Weyerhaeuser Timber Co., and visits to a number of the pulp and paper mills located near Portland, Ore., R. J. Le Roux of the Weyerhaeuser Timber Co., and A. G. Natwick of the Crown Zellerbach Corp., were co-chairman of the meeting. W. F. Holzer of the Crown Zellerbach Corp. was program chairman.

In the spring of 1950 the Coating Committee held its first conference at Grand Rapids, Mich., and in the spring of 1950, another Fundamental Research Conference was held in Quebec, Canada. This meeting was a joint venture with the Technical Section of CPPA.

Other functional meetings sponsored by the Association were the Fourth and Fifth Engineering Conferences, Fibrous Agricultural Residues Conferences, Second Plastics Conference, Testing Conference, and the Alkaline Pulping Conference.

No new local sections were established in 1949 but during 1948 a group known for the present as the Lake Erie Papermaker's and Converter's Association was established in Cleveland, Ohio, to serve a large area from Erie, Pa., to Monroe, Mich., and south to Central Ohio.

The new Association magazine *Tappi* completed its second year of publication in December, 1950. This magazine continued as a medium of publication of the papers presented at all of the Association meetings, the record of Association activities, a number of special and contributed articles and features. The papers presented at the Fundamental Research Conference at Quebec were printed in complete sequence and separate reprints of the collective papers were made. It was interesting to note the number of papers of which reprints are made for the authors. In many cases the reprint order was large, reflecting thereby the large number of individuals, presumably nonmembers, who eventually receive them.

In 1950 the annual edition of the bibliography was not published, a five year (1946–50) volume being prepared.

Two monographs in the coated paper series went to the printer during the latter part of 1950. These dealt with "Paper Coating Machinery" and "Adhesives for Paper Coatings."

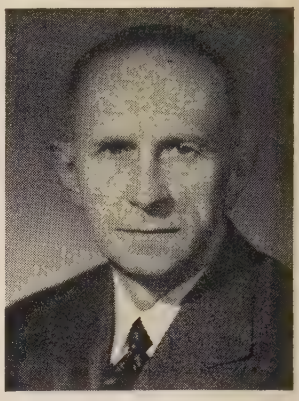
In April, 1950, the Association published in loose-leaf form a series of 157 Routine Control Methods. These methods represent testing procedures in actual use in pulp and paper mills throughout the country. Although they are not Association standards many of them may become suggested methods or tentative standards at some time in the future.

During 1949 a questionnaire was sent to the Association membership requesting samples of papermaking fibers. The response to this request was excellent with several hundred samples being offered. The returned questionnaires were studied by The Institute of Paper Chemistry staff to determine which samples would be accepted for the Fibrary which is located at the Institute. The purpose of the Fibrary was that it is to be the source which may be called upon by individuals or companies to supply them with fiber samples of known origin and history. These can be studied microscopically as a basis for determining the nature of undetermined fibers. This service was requested by the TAPPI Testing Conference held at the Mellon Institute in Pittsburgh, Pa., on Oct. 11–14 1948. The need for such a service was considered to be urgent.

K. P. Geohegan

K. P. Geohegan, vice-president of the Howard Paper Mills, Inc., was president for two terms 1951–52 and G. H. Pringle of the Mead Corp., was vice-president.

A. E. Bachmann
1949–1950



K. P. Geohegan
1951–1952

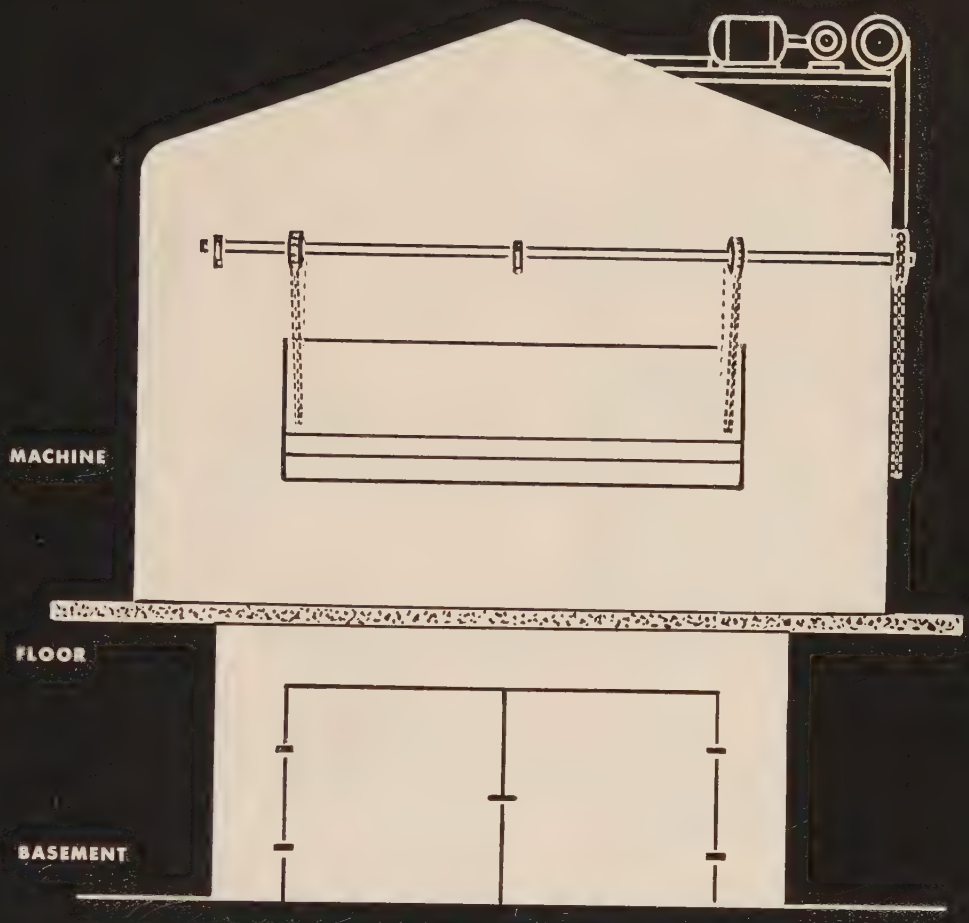
In Mr. Geohegan's term of office the membership increased to 5090 individual members, 234 corporate members, and 209 sustaining members.

During the 1951–52 period in addition to the two annual meetings, 14 functional meetings were held: the Second and Third Coating Conferences, the Sixth and Seventh Engineering Conferences, the Seventh and Eighth Plastics Conferences, the Fourth Fundamental Research Conference, the Fifth and Sixth Alkaline Pulping Conferences, the Third Testing Conference, the Ninth Fibrous Agricultural Residues Conference, and a seminar on Statistics which was held at the University of Maine. This last meeting differed from the other meetings in that it was conducted on a lecture and work shop basis over a period of two weeks.

The Lake Erie Section received its charter as a local section of the Association on May 18, 1951, at the Statler Hotel, Cleveland, Ohio.

A new group, temporarily designated as the Southeastern Pulp and Paper Society, was established at a meeting held at the Dempsey Hotel, Macon, Ga., on May 4, 1951. Glenn C. Kimble of the Union Bag & Paper Corp., Savannah, Ga., presided as chairman. The Southeastern Section received its chapter on Sept. 19, 1952, at the King and Prince Hotel, Sea Island, Brunswick, Ga.

Tappi, the monthly technical magazine of the Association, completed its third successful year in December, 1951. In June, 1951, at the National Industrial Advertisers Association meeting, *Tappi* received the first prize plaque for editorial achievement for Class, Institutional, and Professional Papers for publishing the best series of articles during the period ending Dec. 31, 1950. This award was made by the publication *Industrial Marketing* who sponsored our editorial competition participated in by more than 600 publications. The publication leading to this award were the papers presented during the Fundamental Research Conference at Quebec, Que., in 1950.



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The Bibliography of Paper Making was issued in 1951 as a collective bibliography covering the years 1946–50, inclusive. The patents for 1950 were omitted and were published in combination with the 1951 patents in the 1952 annual. C. J. West chairman of the TAPPI Bibliography Committee, continued as the compiler of the 1946–50 work.

The other publications of the Association were continued on their past basis.

G. H. Pringle

George H. Pringle, vice-president in charge of white paper operations, Mead Corp., served two terms as president of the Association during 1953–54. K. O. Elderkin of Bowaters Southern Paper Corp. was vice-president.

There were 6277 individual members, 259 corporate members, and 245 sustaining members at the end of 1954. Quoting from Mr. Pringle's presidential address:

"It is rather difficult to select any single factor to show the growth of TAPPI during the last 40 years in comparison with the pulp and paper industry. I have, however, made one comparison which is shown in Fig. 1 on the basis of individual TAPPI members, as compared with paper and paperboard production, and I believe the information shown in this chart gives us a pretty good indication of how the Technical Association has grown in comparison with our industry since 1915.

Table I. U. S. Paper and Paperboard Production and Individual TAPPI Memberships Since 1941

Year	*U.S. paper and paperboard production, tons*	*Individual TAPPI memberships*
1914	5,203,535	0
1919	6,190,361	475
1924	7,929,985	584
1929	11,140,235	1166
1934	9,186,266	1127
1939	13,509,642	1645
1944	17,275,264	2128
1949	20,315,436	3615
1953	26,458,781	5693

"Figure 1 and Table I show that, in a general way, the growth of TAPPI has pretty well followed the growth of the industry from 1914 to 1944.

"In 1915 the industry produced about 5 million tons and in 1944 approximately 17 million tons. The Technical Association, with a membership of 201 in 1915 had a membership of a little over 2000 in 1944.

"The growth of TAPPI since 1944, however, which you can readily see from these data, has been much more rapid than the increased production in the industry. The TAPPI membership has increased over 300% from 1944 to 1954, with an approximate individual membership at the end of 1954 of 6400. During this same period the production of the industry has come from 17 million tons in 1944 to 26½ million tons in 1953 which is only a little over 50% increase.

"This phenomenal growth of TAPPI during the last 10 years in comparison with the industry can be attributed, in my opinion, to the following factors:

"1. The realization by top management in the pulp and paper industry that a sound technical education is a good foundation for executive positions in all

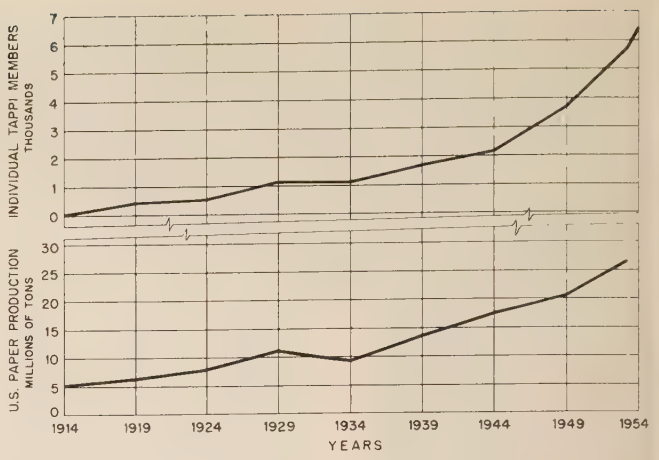

Fig. 1

branches of the industry and not confined to technical service and engineering.

"2. By 1944 the industry had progressed to such a point technically that more positions required a sound technical education than previously.

"3. During the 1930's the industry could not afford to train any young men, and, during the early 1940's these young men were not available. As a result of this, in the late forties, top management realized that they were losing, due to death or retirement, a large number of their top supervisors and executives and were faced with the necessity of training successors for these employees in a comparatively short time. The only group that they considered could develop rapidly enough to fill these positions were the young men coming out of our universities with a technical education.

"4. Due to the increased services offered to the members of the Technical Association, such as *Tappi*, the reorganization and increased activity of the various divisions of TAPPI, made more men realize the advantages to be derived from membership in this organization."

As previously mentioned, with the exception of 1945, annual meetings have been held in February each year. In addition to the annual meetings during 1954 and in 1954 a number of functional meetings were held devoted to coating, statistics, fundamental research, alkaline pulping, engineering, agricultural residues, testing and corrugated containers. In this 2-year period 16 such meetings were held.

No new local sections were chartered, however, in 1954 a group of members held a meeting in Richmond, Va., under the designation of the Chesapeake and Allegheny Paper Club. At a later date this group may apply for a charter. Considerable discussion was occasioned by a request from several European members to form a section on that continent. In 1955 they held a meeting in Paris, France.

Monograph 10, "Bleaching of Pulp"; 11, "Preparation of Paper Coating Colors"; 12, "Inspection of Digesters"; 13, "Wet Strength in Paper and Paperboard"; and 14, "Anatomy of Common North American Pulpwood Barks" were issued in addition to the regular publications of the Association.

At this point it may be well to mention that the Association has assisted many individuals to obtain

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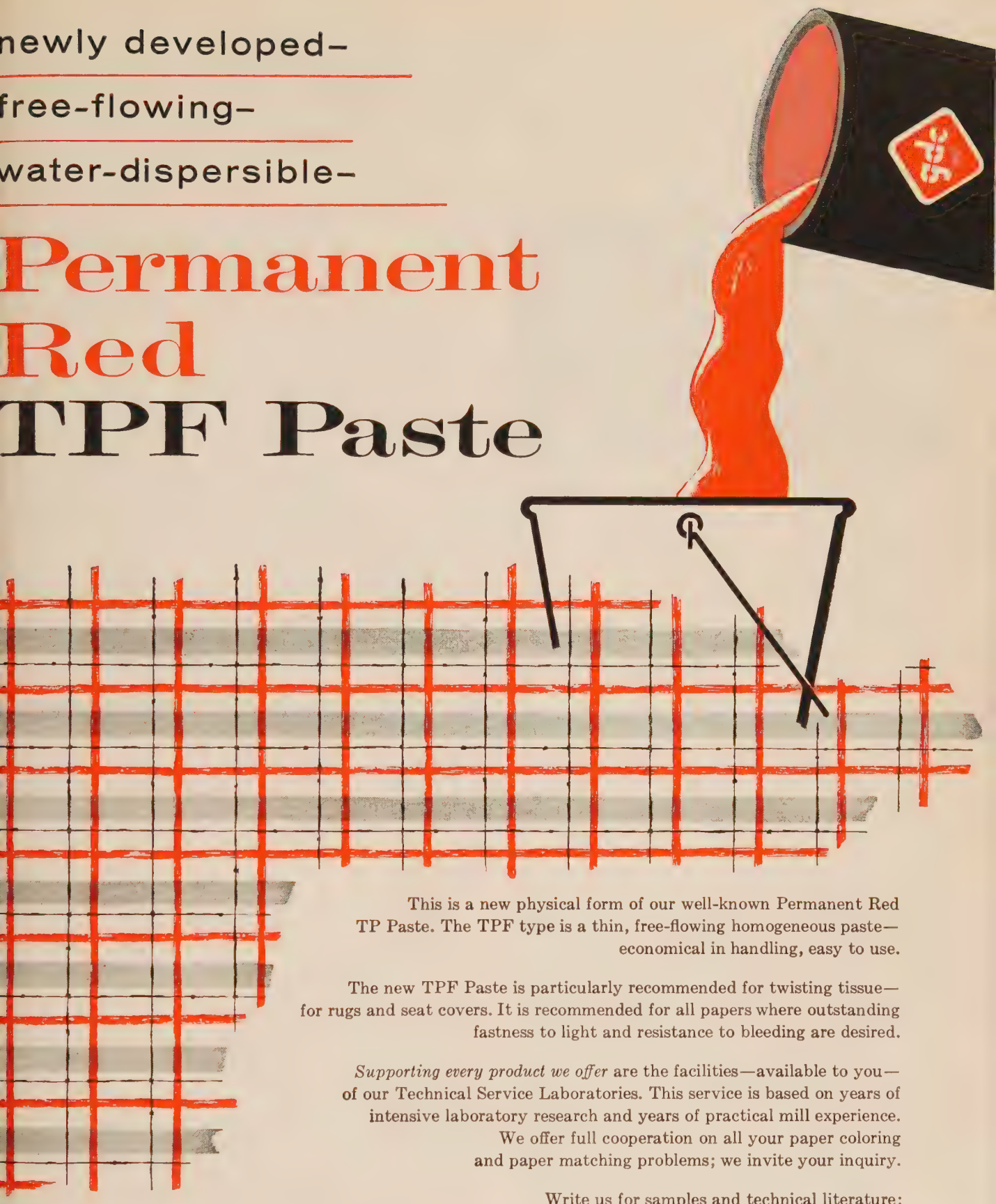

This is a new physical form of our well-known Permanent Red TP Paste. The TPF type is a thin, free-flowing homogeneous paste—economical in handling, easy to use.

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Supporting every product we offer are the facilities—available to you—of our Technical Service Laboratories. This service is based on years of intensive laboratory research and years of practical mill experience. We offer full cooperation on all your paper coloring and paper matching problems; we invite your inquiry.

Write us for samples and technical literature; call upon our skilled technical service.

From Research to Reality

gdc gaf

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A SALES DIVISION OF GENERAL ANILINE & FILM CORPORATION

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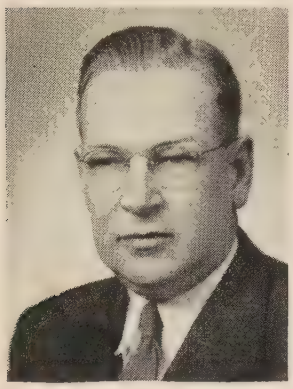
positions in the paper industry and likewise, assisted companies in securing personnel. With the publication of the Association magazine, *Tappi*, this service was augmented by a section "TAPPI Employment Service" in which the various requests are published.

In July, 1953, because of crowded office conditions, the Association moved its offices from 122 E. 42nd St., to the 31st floor at 155 E. 44th St., in New York.



G. H. Pringle
1953–1954

K. O. Elderkin
1955–

In his summation of the 40-year history of the Association, Mr. Pringle stated:

"In order to maintain the position that TAPPI now holds in the pulp and paper industry and to continue to grow and prosper, it will be necessary for each individual member of TAPPI to do the following:

"1. Give your wholehearted support to all the activities of National TAPPI by serving on national committees, attend and participate in national meetings, and provide assistance to the national organization in any way that you are best qualified to provide it.

"2. Support your local section by attendance at local meetings, participation in the programs, and serving on committees.

"3. Take an active part in an educational program in your community so that more high school students realize the advantages of a technical education and enter a university to obtain a technical degree. Assist in following through with these students so that upon graduation they will join the pulp and paper industry.

"The Ohio Section of TAPPI has set up an educational committee to work with the high schools in the Ohio Section area, putting on a program to point out to the high school students the advantages of employment in the pulp and paper industry. They plan to follow through with these students so that after they graduate from the university they will obtain permanent employment in our industry.

"I think this is a very worth-while project because it is definitely necessary for us to obtain more young technically trained men in our industry. I believe this would be a worth-while committee project for every section of TAPPI to consider.

"4. Point out to the technical men in your own organization, as well as others in the industry that you contact who are not members of TAPPI, the advantages of membership and all the benefits that can be derived from joining this organization. In this way we can get more technical men to join TAPPI and thus build up a stronger organization.

"5. Endeavor to impress upon the technical men in the industry the importance of the practical men to our operations. This is particularly true of the young graduates entering our industry. We should make a particular point to impress upon these young graduates the importance of working with these experienced practical employees in order to obtain the full benefit of their background and experience."

K. O. Elderkin

In February, 1955, K. O. Elderkin, vice-president of Bowaters Southern Paper Corp., was elected president of TAPPI and Ward D. Harrison, vice-president of the Riegel Paper Corp., was elected vice-president. Mr. Elderkin is the 24th to become president of the Association.

R. G. Macdonald

R. G. Macdonald became secretary-treasurer of the Association in December 1927, succeeding William G. MacNaughton who resigned to become engineer for the News Print Service Bureau. Prior to his election Mr. Macdonald was a chemical engineering student at the Massachusetts Institute of Technology, with the Pejepscot Paper Co., the Oxford Paper Co., and *Chemical and Metallurgical Engineering*, a McGraw-Hill publication.

Carrying out the policies formulated by the Executive Committee, Mr. Macdonald has been active in promoting committee activities, organizing and assisting local sections, handling publications and assisting the Executive Committee in administrating the extensive affairs of the Association.

In 1943, V. F. Waters, who had assisted Mr. Macdonald as technical assistant since 1938, left to join the Ernest H. Abernathy Publishing Co., Inc., and was replaced by Richard T. Bingham, formerly with the Titanium Div., National Lead Co. and the Imperial Paper & Color Corp. In 1953, A. J. Winchester, who was with the Donnacona Paper Co., Ltd., also joined the staff of the Association.

The TAPPI Attitude

In passing it is interesting to refer back to an item which appeared in the *Journal of Commerce*, a leading New York financial paper, in October, 1917. It probably could be written in the same vein today.

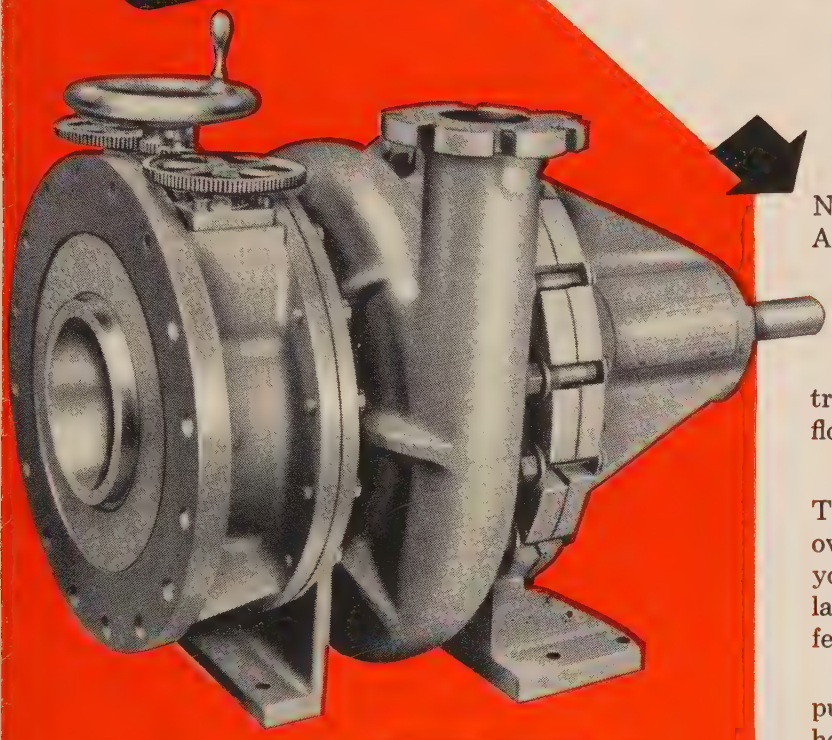
"Altruism and cooperative fellowship evidently permeate the paper industry, as they do in some other business organizations. Here are men of international reputations as experts, occupying responsible positions with the largest concerns, freely giving their competitors and the industry in general the benefit of their experimentation and learning, not for selfish gain, but for the common uplift of the entire industry. And in some cases it has a distinctly patriotic tendency."

CONSTITUTION AND CODE OF ETHICS

The growth and organization problems of the Association has been reflected in the changes that have been made in its Articles of Organization. The present document consisting of a Constitution and Bylaws was adopted in 1940 and revised in September, 1949. The Constitution may be amended by the Association members and the Bylaws by the Executive Committee.

ALLIS-CHALMERS
Proportioning
PUMP

Gives Positive Stock Delivery Control



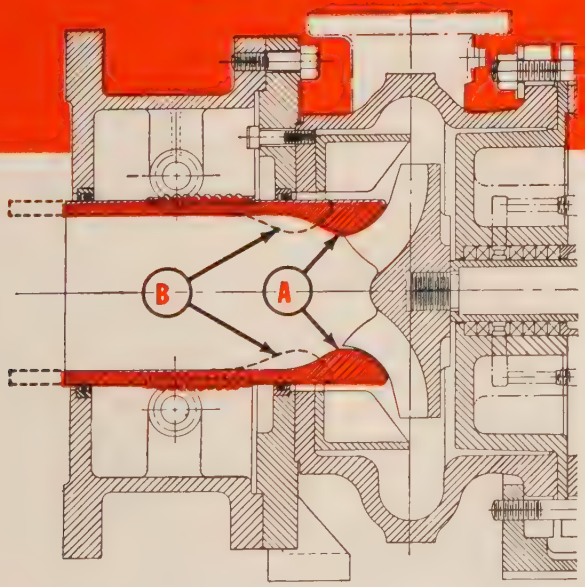
No need to regulate pump speed using Allis-Chalmers new proportioning pump.

Key to this revolutionary *ACAP* pump is an internal bypass mechanism — bolted on the inlet of a single-suction pump. Bypass mechanism can be controlled automatically or manually to reduce flow of stock when needed.

Provides Agitated Stock Flow

This pump gives positive, accurate control over paper stock delivery. It also permits you to maintain constant agitated recirculation for blending purposes without affecting uniform delivery of stock.

Get complete details on the new *ACAP* pumps for proportioning, fan service or head box supply. Contact your nearby district office or write Allis-Chalmers, Milwaukee 1, Wisconsin.



ACAP is an Allis-Chalmers trademark.

- ***Operates at any point on the curve***
- ***No Valves to clog or clean***

Adjustment of the actuating mechanism slides the bypass cylinder toward or away from the impeller. The clearance between pump end of the cylinder and the impeller determines the amount of stock recirculation — regulates the flow at the discharge nozzle.

At Position *A* (see diagram) outlet flow is at maximum, recirculation slight; at Position *B*, outlet flow is minimum, recirculation is maximum.

A-4773

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

The objects of the Association are cited as follows:

(a) To further the application of the sciences in the pulp and paper industry.
(b) To promote investigation, research, and interchange of ideas among its members in the field of pulp and paper manufacture and use.
(c) To promote education in the science and practice of pulp and paper manufacture.
(d) To arrange for the collection and dissemination of information relating to the pulp and paper industry and for the presentation, discussion and publication of papers and other contributions.
(e) To provide technical facts data and standards, fundamental to pulp and paper manufacture and use.
(f) To promote the professional, social, and economic welfare of its members.

There are five classes of individual members and two of company members. Of the former there are active, associate, affiliate, student, and overseas members and of the latter, corporate and sustaining. The individual members are expected to have a technical training and to be engaged in the manufacture of pulp and paper or in work of a technical character in industries, institutions or services related thereto. The corporate members are paper and pulp companies and the sustaining members are companies in the allied industries. Only active members may hold office and both active members and the official representatives of corporate members may vote.

Officers are elected by a mail ballot which has been prepared by a nominating committee appointed by the Executive Committee. A group of at least twenty-five active members may propose candidates whose name may appear on the ballot.

Provision is made for the establishment and administration of local sections, dues, standards, committees, amendments, etc.

Code of Ethics

On Feb. 13, 1933, the Association adopted a code of ethics to guide the professional conduct of its members and it was revised Sept. 15, 1941. This provides for the following:

1. He shall guard and uphold the high standard of honor for which the association stands, by fidelity to the interests of his employees, or clients and by a fine spirit of courtesy and friendliness in his intercourse with all members of the association.
2. In all his relations he shall be guided by the highest principles of honor and thus maintain the dignity and higher reputation of the association.
3. He shall not use any unfair, improper, or questionable method in securing employment.
4. He shall, when he is an executive and an employer of members of the association, act fairly and with consideration in his relations with member employees.
5. He shall carefully avoid any interference with the business of a fellow member by overtures to any member's employees for professional services for the divulging of technical methods of processes known to such an employee.
6. He shall cooperate in improving the application of technical information as connected with the pulp and paper industry, and will also, as far as seems wise, exchange general information and experience with fellow members, and will further make more valuable the association by contributing technical papers where such information does not conflict with the interest or interests of his employer or client.
7. He shall be frank in the expression of opinion regarding work requested of him by clients or employers where such work seems to present improbabilities of successful results and shall advise before undertaking the work.
8. He shall be diligent in exposing and opposing such errors and frauds as his experience and knowledge enables him to recognize.
9. He shall not use undignified, sensational, or misleading language on advertising that is likely to discredit him or his membership in this association.
10. He shall not issue and shall discourage his associates from issuing any publicity featuring statements made in papers or articles published by him through the medium of the association, which will exaggerate or otherwise improperly represent the facts as stated in such articles.
11. He shall interest himself in the public welfare in behalf of which he will be ready to apply his special knowledge, skill and training for the use and benefit of mankind.
12. In all cases not covered by the above it is suggested that a close observance of the Golden Rule, may be regarded as a proper guide of conduct.

THE TAPPI EXECUTIVE COMMITTEE

The success of the Technical Association, as with other professional societies, has reflected the initiative and ability of its leadership and the cooperation of the members. From the beginning the Association has elected its officers and executive committeemen on the basis of their demonstrated service to the Association and to the industry. In 1915 the three officers and three members constituted the committee. Today there are fourteen members on the committee, generally representing the major paper grades, pulp and paper-making regions, and the professions and arts represented in the membership.

Although the term of the officers has been but 1 year, in most cases they have been called to serve a second term. One third of the executive committee has been elected each year to succeed those who have served 3 years.

In practice, the executive committee has devoted its attention largely to policy forming matters and has passed on the qualifications of all candidates for membership. Since most of the subjects dealt with have been of major concern to the organization they have been assigned to subcommittees of the committee for thorough study and recommendations.

The committee meets when called by the president. The annual meeting of the committee is usually held on the day preceding the annual meetings. Whenever the occasion requires meetings may be called at other times. In the periods between such meetings a considerable amount of work is carried on by correspondence, thereby reducing the need of more frequent meetings.

Following is a list of the members who have served on the executive committee during the past 40 years. The first two names in each case refer to the president and vice-president.

1915
H. E. Fletcher
W. G. MacNaughton
C. F. Rhodes
H. F. Obermanns
E. Mahler
T. J. Keenan

1916
H. E. Fletcher
W. G. MacNaughton
C. F. Rhodes
H. F. Obermanns
E. Mahler
T. J. Keenan

1917
W. G. MacNaughton
H. P. Carruth
H. F. Obermanns
E. Mahler
H. E. Fletcher
T. J. Keenan

1918
H. P. Carruth
H. F. Obermanns
H. E. Fletcher
R. S. Hatch
F. C. Clark
T. J. Keenan

1919
R. S. Hatch
R. B. Wolf
H. E. Fletcher
F. C. Clark
H. P. Carruth
O. L. E. Weber
G. E. Williamson
T. J. Keenan

1920
R. S. Hatch
R. B. Wolf
H. E. Fletcher
F. C. Clark

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- ☐ No. 6—Caustic Soda
- ☐ No. 7—Liquid Chlorine
- ☐ No. 8—Alkalies and Chlorine in the Treatment of Municipal and Industrial Water
- ☐ No. 9—Analysis of Alkalies
- ☐ No. 11—Water Analysis
- ☐ No. 12—The Analysis of Liquid Chlorine and Bleach
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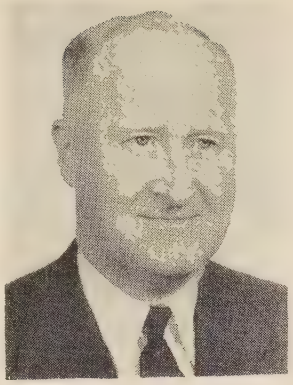
W. D. Harrison, Riegel Paper Corp.; Vice-President TAPPI



R. G. Macdonald, Secretary-Treasurer TAPPI

H. P. Carruth
G. E. Williamson
R. S. Kellogg
T. J. Keenan

1921

G. E. Williamson
F. C. Clark
R. S. Kellogg
G. N. Collins
G. H. Harvey
E. C. Tucker
G. K. Spence
W. G. MacNaughton

1922

G. E. Williamson
F. C. Clark
R. S. Kellogg
G. N. Collins
G. H. Harvey
E. C. Tucker
G. K. Spence
W. G. MacNaughton

1923

H. S. Taylor
G. N. Collins
R. S. Kellogg
G. H. Harvey
E. C. Tucker
G. K. Spence
B. T. McBain
W. G. MacNaughton

1924

H. S. Taylor
G. N. Collins
R. S. Kellogg
E. C. Tucker
B. T. McBain
W. E. B. Baker
L. J. Parent
W. G. MacNaughton

1925

G. K. Spence
E. C. Tucker
R. S. Kellogg
B. T. McBain
W. E. B. Baker
L. J. Parant
D. C. Everest
W. G. MacNaughton

1926

G. K. Spence
E. C. Tucker
R. S. Kellogg
B. T. McBain
W. E. B. Baker
L. J. Parant
D. C. Everest
H. O. Keay
R. H. Laftman
W. G. MacNaughton

1927

E. C. Tucker
P. H. Glatfelter
Allen Abrams
R. S. Kellogg
H. O. Keay
R. H. Laftman
B. T. McBain
M. A. Krimmel
E. R. Low
W. G. MacNaughton

1928

E. C. Tucker
P. H. Glatfelter
Allen Abrams
H. O. Keay
R. H. Laftman
B. T. McBain
M. A. Krimmel
E. R. Low
W. G. MacNaughton
R. G. Macdonald

1929

P. H. Glatfelter
M. A. Krimmel
Allen Abrams
R. H. Laftman
W. G. MacNaughton
R. A. Hayward
W. O. Johnson
R. Bell-Irving
J. S. Bates
R. G. Macdonald

1930

M. A. Krimmel
R. H. Laftman
W. O. Johnson
J. H. Slater
Allen Abrams
J. S. Bates
C. C. Heritage
W. G. MacNaughton
R. Bell-Irving
R. G. Macdonald

1931

M. A. Krimmel
Allen Abrams
J. S. Bates
R. Bell-Irving
C. C. Heritage
W. O. Johnson
J. H. Slater
G. N. Collins
J. F. Rhoades
R. G. Macdonald

1932

Allen Abrams
C. C. Heritage
W. O. Johnson
J. H. Slater
M. A. Krimmel
G. N. Collins
J. F. Rhoades
G S Holmes
R A. Hayward
W. S. Kidd
B. T. Larrabee
R. G. Macdonald

1933

Allen Abrams
C. C. Heritage
G. N. Collins
J. F. Rhoades
H. R. Murdock
R. A. Hayward
W. S. Kidd
B. T. Larrabee
Otto Kress
W. R. Maull
E. O. Reed
R. G. Macdonald

1934

C. C. Heritage
G. N. Collins
R. A. Hayward
W. S. Kidd
B. T. Larrabee
Otto Kress
W. R. Maull
E. O. Reed
H. P. Carruth
H. U. Kiely
H. R. Murdock
R. G. Macdonald

1935

C. C. Heritage
G. N. Collins
E. O. Reed
W. R. Maull
H. R. Murdock
Otto Kress
H. P. Carruth
H. U. Kiely
A. E. H. Fair
W. J. Lawrence
Albert Bankus
R. G. Macdonald

1936

G. N. Collins
W. R. Maull
H. U. Kiely
H. R. Murdock
G. W. E. Nicholson
Albert Bankus
A. E. H. Fair
W. J. Lawrence
R. C. Griffin
W. H. Swanson
M. H. Teaze
R. G. Macdonald

1937

G. N. Collins
W. R. Maull
Albert Bankus
A. E. H. Fair
W. J. Lawrence
R. C. Griffin
W. H. Swanson
M. H. Teaze
H. R. Murdock
W. M. Shoemaker
John Traquair
R. G. Macdonald

1938

F. C. Clark
H. R. Murdock
F. D. Libby
R. C. Griffin
W. H. Swanson
M. H. Teaze
Albert Bankus
G. D. Bearce
W. M. Shoemaker
John Traquair
L. C. Anderson
G. S. Brazeau
G. W. E. Nicholson
B. M. Thomas

1939

F. C. Clark
W. H. Swanson
Albert Bankus
G. D. Bearse
W. M. Shoemaker
John Traquair
D. C. Anderson
G. S. Brazeau
G. W. E. Nicholson
B. M. Thomas
F. D. Libby
R. C. Griffin
V. P. Edwardes
H. H. Harrison

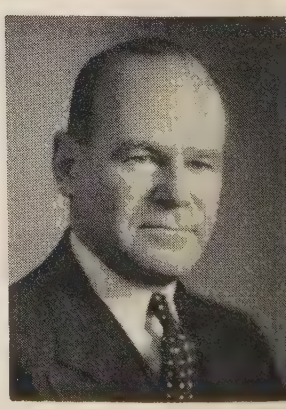
1940

W. H. Swanson
R. A. Hayward
L. C. Anderson
G. S. Brazeau
G. W. E. Nicholson
B. M. Thomas
V. P. Edwardes
H. H. Harrison
R. C. Griffin
F. D. Libby
Albert Bankus
G. Lemont Bidwell, Jr.
M. P. Chaplin
J. L. Parsons

1941

W. H. Swanson

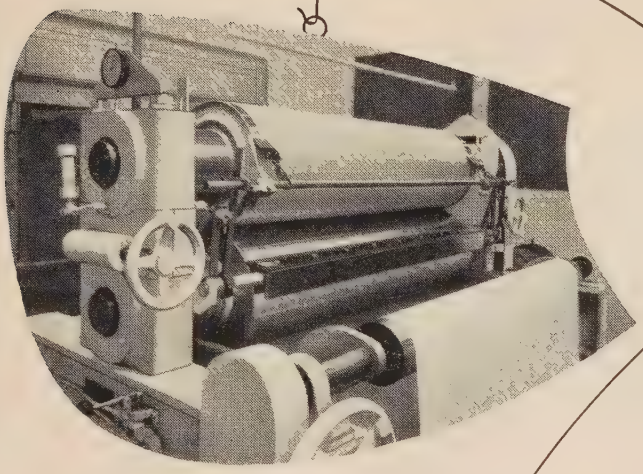
N. I. Bearse, Champion-International Co.; Executive Committee (1953–56)



John Buss, Provincia Paper, Ltd.; Executiv Committee (1953–56)

Still another installation by a leading producer demonstrates the advanced planning and efficiency of Frank W. Egan & Company design. This TREATER was chosen to produce Formica laminated sheets for decorative and industrial applications because it turns out the highest percentage of perfect material and treats the base stock *uniformly*. An Egan exclusive is the micrometer gauge for exact control and finest adjustment *while operating*.

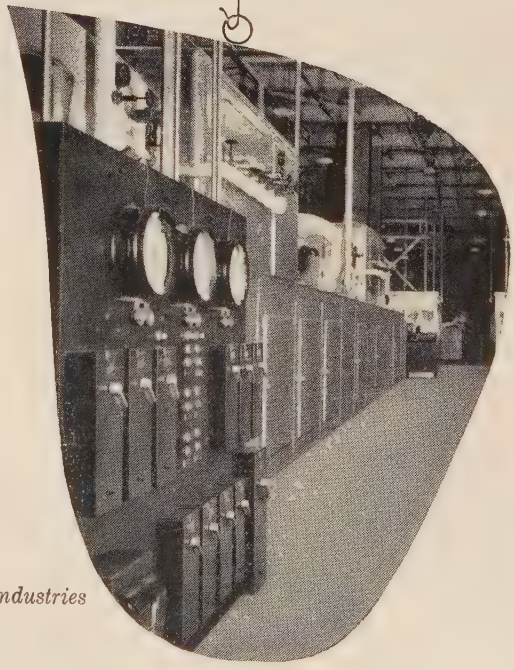
Egan



Treater

FOR LAMINATED PLASTICS INDUSTRY

Supplied to THE FORMICA COMPANY



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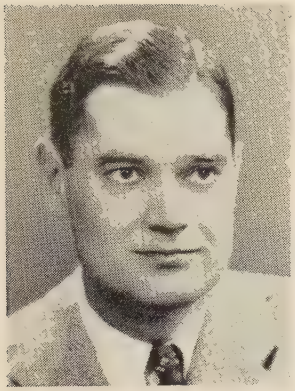


H. C. Moore, Beloit Iron Works; Executive Committee (1953–56)

C. J. Sibler, West Virginia Pulp & Paper Co.; Executive Committee (1953–56)

R. A. Hayward
V. P. Edwardes
H. H. Harrison
R. C. Griffin
F. D. Libby
Albert Bankus
G. Lamont Bidwell, Jr.
M. P. Chaplin
J. L. Parsons
Pierre Drewsen
H. H. Hanson
B. D. Millidge
G. W. E. Nicholson

1942

Ralph A. Hayward
V. P. Edwardes
Albert Bankus
G. Lamont Bidwell, Jr.
M. P. Chaplin
J. L. Parsons
Pierre Drewsen
H. H. Hanson
B. D. Millidge
G. W. E. Nicholson
W. E. Brawn
O. P. Gephart
C. R. Seaborne
R. S. Wertheimer

1943

Ralph A. Hayward
Vance P. Edwardes
Pierre Drewsen
H. H. Hanson
B. D. Millidge
G. W. E. Nicholson
W. E. Brawn
O. P. Gephart
C. R. Seaborne
R. S. Wertheimer
A. E. Bachmann
Paul Hodges
J. D. Malcolmson
A. E. Montgomery

1944

Vance P. Edwardes
G. W. E. Nicholson
W. E. Brawn
O. P. Gephart
C. R. Seaborne
R. S. Wertheimer
A. E. Bachmann
W. F. Gillespie
J. D. Malcolmson
A. E. Montgomery
F. W. Brainerd
Pierre Drewsen
K. P. Geohegan
J. C. Nutter

1945

Vance P. Edwardes
G. W. E. Nicholson
A. E. Bachmann
W. F. Gillespie
J. D. Malcolmson
A. E. Montgomery
F. W. Brainerd
Pierre Drewsen
K. P. Geohegan
J. C. Nutter
W. R. Barber
W. E. Brawn
J. A. Hanson
J. A. Wise

1946

G. W. E. Nicholson
W. E. Brawn
F. W. Brainerd
Pierre Drewsen
K. P. Geohegan
J. C. Nutter
A. E. Bachmann
W. R. Barber
J. A. Hanson
J. A. Wise
G. J. Brabender
E. F. Burns
W. F. Gillespie
J. W. Hemphill

1947

W. E. Brawn*
W. F. Gillespie
W. R. Barber
A. E. Bachmann
J. A. Hanson
J. A. Wise
G. J. Brabender
Werner Kaufmann
J. d'A. Clark
J. W. Hemphill
J. D. Davis
K. P. Geohegan
A. C. Hill
R. A. Wilkins

* Died during term of office.

1948

W. F. Gillespie
A. E. Bachmann
C. J. Brabender
Werner Kaufmann
J. d'A. Clark
J. W. Hemphill
J. D. Davis
K. P. Geohegan
A. C. Hill
R. A. Wilkins
H. W. Bialkowsky
F. C. Goodwill
W. B. Lincoln, Jr.
A. L. Sherwood, Jr.

1949

A. E. Bachmann
K. P. Geohegan
J. D. Davis
K. O. Elderkin
A. C. Hill
R. A. Wilkins
H. W. Bialkowsky
F. C. Goodwill
W. B. Lincoln, Jr.
A. L. Sherwood, Jr.
J. d'A. Clark
M. L. Downs
G. H. Pringle
Werner Kaufmann

1950

A. E. Bachmann
K. P. Geohegan
H. W. Bialkowsky
F. C. Goodwill
R. P. Price
A. L. Sherwood
J. d'A. Clark
M. L. Downs
G. H. Pringle
Werner Kaufmann
K. O. Elderkin
Milton Jacobs
R. W. Kumler
G. E. Shipman

1951

K. P. Geohegan
G. H. Pringle
J. d'A. Clark
M. L. Downs
J. R. Lientz
Werner Kaufmann
K. O. Elderkin
Milton Jacobs
R. W. Kumler
G. E. Shipman
W. D. Harrison
W. F. Hathaway
W. F. Holzer
R. P. Price

1952

K. P. Geohegan
G. H. Pringle
K. O. Elderkin
Milton Jacobs
R. W. Kumler
G. E. Shipman
W. D. Harrison
W. F. Hathaway
W. F. Holzer
R. P. Price
L. K. Burnett
G. A. Day
H. F. Lewis
J. R. Lientz

1953

G. H. Pringle
K. O. Elderkin
W. D. Harrison
W. F. Hathaway
W. F. Holzer
R. P. Price
L. K. Burnett
G. A. Day
H. F. Lewis
J. R. Lientz
N. S. Bearse
John Buss
H. C. Moore
C. J. Sibler

1954

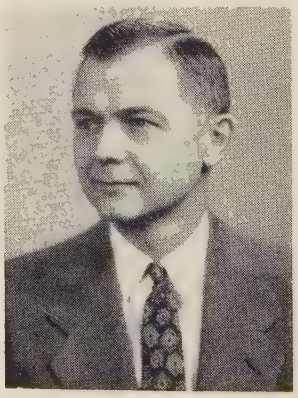
G. H. Pringle
K. O. Elderkin
L. K. Burnett
G. A. Day
H. F. Lewis
J. R. Lientz
N. I. Bearse
John Buss
H. C. Moore
C. J. Sibler
R. L. Davis
W. D. Harrison
F. D. Long
R. I. Thieme

1955

K. O. Elderkin
W. D. Harrison
N. I. Bearse
John Buss
H. C. Moore
C. J. Sibler
R. L. Davis
E. O. Ericsson
F. D. Long
J. D. Lyall
D. J. Goodman
J. R. Lientz
J. J. Thomas
J. C. Wollwage

THE MEETING PLACES OF THE ASSOCIATION

Since 1915 the Annual Meeting of the Association has always been held in New York City, first at the old Waldorf-Astoria on Fifth Ave. and 34th St. When this building was torn down to make way for the Empire State Building the Association met at the Pennsylvania Hotel on Seventh Ave. and 33rd St. from 1930 to 1933,

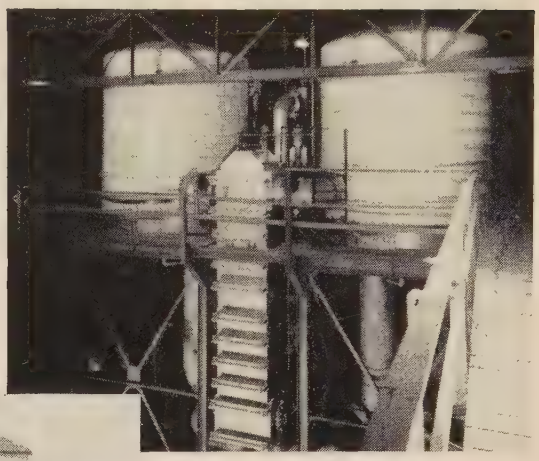


R. L. Davis, Scott Paper Co.; Executive Committee (1954–57)

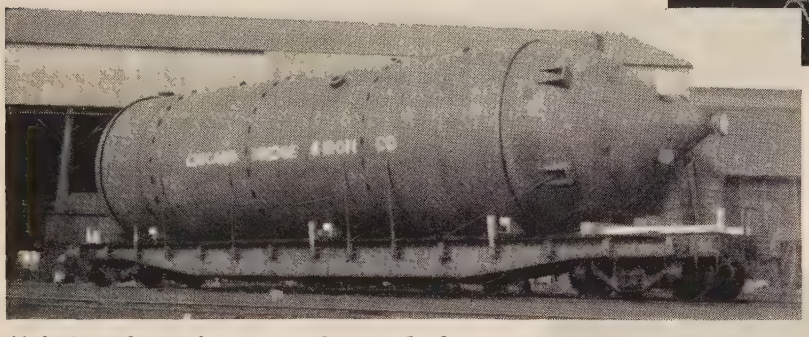
E. O. Ericsson, Puget Sound Pulp & Paper Co.; Executive Committee (1954–57)

It takes the best equipment...

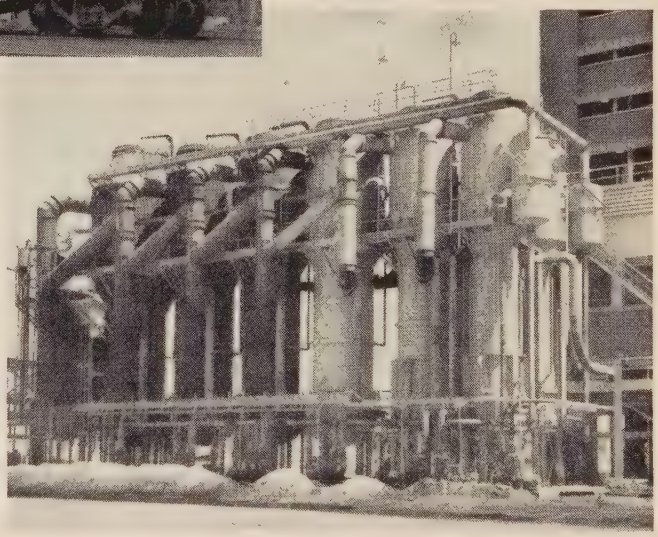
to make the best pulp!



Conkey Channel Switching Evaporator (Rosenblad Patents) operating on sulphite pulp mill waste liquors.



11 ft. 7 in. by 51 ft. 10½ in. digester built by CB&I for the Mead Corporation, Chillicothe, Ohio.



Conkey Sextuple Effect Evaporator, code constructed throughout, operating on sulphate black liquor.

• *The best of anything doesn't just happen.* When it's the best of pulp, it takes work, planning—and the finest in equipment.

CB&I digesters are built to "take it" for constant cooking operation. Conkey evaporators provide operators with the type of equipment that helps produce the best product . . . to help make profits.

CB&I plants are completely equipped to meet your most exacting specifications. For further information on Conkey equipment and other CB&I structures, write our nearest office.

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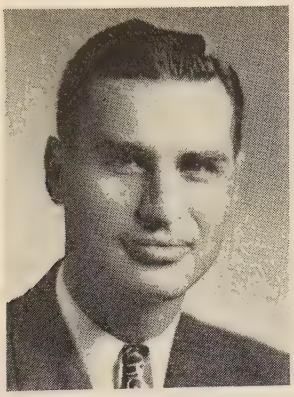
Los Angeles • New York • Philadelphia • Pittsburgh • Salt Lake City
San Francisco • Seattle • Tulsa



F. D. Long, Container Corp. of America; Executive Committee (1954–57)

J. D. Lyall, Armstrong Cork Co.; Executive Committee (1954–57)

inclusive. It then met at the new Waldorf-Astoria on Park Ave. from 1934 to 1938, inclusive.

During these years it met at the same time and in the same place as the American Paper and Pulp Association and its affiliated organizations. Because of the National Recovery Act program and the growth in interest in the meetings of the Technical Association it was necessary to find larger quarters. In 1939, therefore, the Association held its Annual Meeting at the Roosevelt Hotel on Madison and Vanderbilt Ave. Although it had the exclusive use of the facilities of this excellent hotel the phenomenal growth in attendance at this meeting forced another change, and in February, 1942, the meeting was held at the Commodore Hotel where it has been located each year to date with the exception of 1945 when the meeting was cancelled because of wartime conditions.

Holding the Annual Meeting in New York during Paper Week has been advantageous since many members are expected to attend meetings of the various trade associations and take advantage of this opportunity to meet customers, representatives, and the many others of kindred interests who are in New York at the time.

The fall meetings were generally held in centers having some paper manufacturing interest. The dates were dependent on expected weather and other conditions. Meetings at Seattle and Montreal have been held as early as August and the meeting at Savannah, Ga., was held as late as mid-October.

Following is a list of the locations of the various fall meetings:

1915	New York, N. Y.	1929	Richmond, Va.
1916	Kalamazoo, Mich. (May)	1930	Erie, Pa.
1917	New York, N. Y. (Sept.)	1931	Kalamazoo, Mich.
1917	Neenah, Wis. (May)	1932	Holyoke, Mass.
1917	Holyoke, Mass. (Sept.)	1933	Appleton, Wis.
1918	Dayton, Ohio	1934	Portland, Ore.
1919	Buffalo, N. Y., and Erie, Pa.	1935	Atlantic City, N. J.
1920	Saratoga Springs, N. Y.	1936	Montreal, P. Q.
1921	No meeting	1937	Savannah, Ga.
1922	Detroit, Mich.	1938	Green Bay, Wis.
1923	Appleton, Wis.	1939	Syracuse, N. Y.
1924	Buffalo, N. Y.	1940	Seattle, Wash.
1925	Kalamazoo, Mich.	1941	Ann Arbor, Mich.
1926	York, Pa.	1942	Boston, Mass.
1927	Middletown, Ohio	1943	Chicago, Ill.
1928	Wausau, Wis.	1949	Portland, Ore.

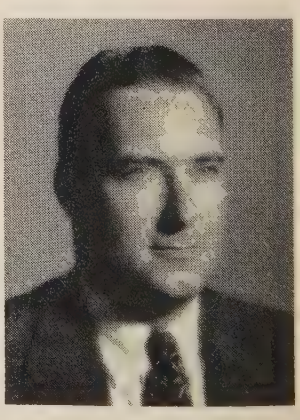
Because of the war, fall meetings were cancelled during 1944 and 1945. However, several committees held meetings to discuss their particular problems and these were the forerunners of the functional meeting program that was started in 1946 and has been continued to the present time.

As the Association membership and the attendance at the fall meetings increased it became more difficult to find locations other than at the large cities. It also affected the programs with the result that less and less time could be assigned to any particular subject. Consequently, in 1946 the Association initiated the policy of arranging separate meetings at which a particular phase or interest could be discussed. These proved to be very successful. In general, the meetings have been organized under the auspices of a division or committee and have been located in areas where it has been possible to make visits to establishments manufacturing products of interest to the particular group. This has tended to place regional restrictions on certain groups, but the general policy has been to shift the meeting locations from year to year. Because of the excellent cooperation of the pulp, paper, and converting companies, the mill visits have become features of each program. The educational and research institutions have also been very cooperative.

The following lists the committees who have sponsored these functional meetings, the places where they have been held, and the meeting dates.

Sept. 25–27, 1946: Fundamental Research Committee, Detroit, Mich.
Oct. 2–4, 1946: First Engineering Conference, Milwaukee, Wis.
Oct. 14–16, 1946: Second Alkaline Pulping & Chemical Products Conference, New Orleans, La.
Sept. 3–5, 1947: Fundamental Research Committee, Appleton, Wis.
Sept. 25–26, 1947: Plastics Committee, Syracuse, N. Y.
Oct. 9–11, 1947: Third Alkaline Pulping Conference, Asheville, N. C.
Oct. 23–24, 1947: Fibrous Agricultural Residues Committee, Alton, Ill.
Nov. 3–5, 1947: Second Engineering Conference, Philadelphia, Pa.
Aug. 16–17, 1948: Plastic Conference, Appleton, Wis.
Aug. 18–20, 1948: Fundamental Research Conference, Madison, Wis.
Sept. 27–29, 1948: First Mechanical Pulping Conference, Poland Spring. Me.
Oct. 11–14, 1948: First Testing Conference, Pittsburgh, Pa.
Oct. 25–28, 1948: Third Engineering Conference, Buffalo, N. Y.
Nov. 15–16, 1948: Fibrous Agricultural Residues Conference, Peoria, Ill.
April 26–27, 1949: First Coating Conference, Grand Rapids, Mich.
Sept. 11–15, 1949: General Fall Meeting, Portland, Ore.

D. J. Goodman, Sorg Paper Co.; Executive Committee (1955–58)



J. R. Lientz, Union Bag & Paper Corp.; Executive Committee (1955–58)

For a new concept in design, engineering and installation of specialized mill lubrication systems, you are invited to call upon Dravo's new Lubrication Section. This new service has been made possible by our recent acquisition of The DeLaval Separator Company's Mill Lubrication Department with its experienced engineering staff. Now Dravo will be able to offer industry another fully engineered service based upon a thorough knowledge of customer requirements. For complete details, write Dravo Corporation, Industrial Department, Dravo Building, Fifth and Liberty Avenues, Pittsburgh 22, Pennsylvania.

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Crane & Co.

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Oct. 31, Nov. 1–3, 1949: Fourth Engineering Conference, Boston, Mass.
Nov. 7–8, 1949: Fibrous Agricultural Residues Conference, Terre Haute, Ind.
May 29–31, 1950: Fundamental Research Conferences, Quebec, Que.
Sept. 13–15, 1950: Second Testing Conference, Rochester, N. Y.
Oct. 2–5, 1950: Fifth Engineering Conference, Cincinnati, Ohio
Oct. 19–20, 1950: Sixth Plastics Conference, Syracuse, N. Y.
Oct. 25–27, 1950: Fourth Alkaline Pulping Conference, Jacksonville, Fla.
Nov. 12–13, 1950: Fibrous Agricultural Residues Conference, Peoria, Ill.
April 18–20, 1951: Second Coating Conference, Boston, Mass.
May 18, 1951: Corrugated Combining Conference, Cleveland, Ohio
Sept. 17–21, 1951: Fundamental Research Conference, Appleton, Wis.
Sept. 26–28, 1951: Fifth Alkaline Pulping Conference, Richmond, Va.
Sept. 15–18, 1951: Sixth Engineering Conference, Savannah, Ga.
Nov. 8–9, 1951: Seventh Plastics Conference, Syracuse, N. Y.
May 5–8, 1952: Third Coating Conference, Chicago, Ill.
Aug. 4–16, 1952: Statistics Conference, Orono, Me.
Sept. 10–12, 1952: Third Testing Conference, Syracuse, N. Y.
Oct. 13–16, 1952: Seventh Engineering Conference, Chicago, Ill.
Oct. 27–28, 1952: Fibrous Agricultural Residues Conference, Peoria, Ill.
Nov. 5–6, 1952: Eighth Plastics Conference, Syracuse, N. Y.
Nov. 12–14, 1952: Sixth Alkaline Pulping Conference, Mobile, Ala.
Nov. 20–21, 1952: Second Corrugated Container Conference, Milwaukee, Wis.
May 25–27, 1953: Fourth Coating Conference, Cincinnati, Ohio
June 15–26, 1953: Second Statistics Conference, Kalamazoo, Mich.
Sept. 15–16, 1953: Ninth Paper-Plastics Conference, Syracuse, N. Y.
Sept. 22–23, 1953: Third Testing Conference, Columbus, Ohio
Oct. 8–9, 1953: Tenth Fibrous Agricultural Residues Conference, Belleville, Ont.
Oct. 15–16, 1953: Third Corrugated Container Conference, New York, N. Y.
Oct. 26–27, 1953: Eighth Engineering Conference, Montreal, Que.
Nov. 18–20, 1953: Seventh Alkaline Pulping Conference, Houston, Tex.
May 26–27, 1954: Fifth Coating Conference, Poland Springs, Me.
Sept. 21–24, 1954: Fundamental Research Conference, Appleton, Wis.
Oct. 6–8, 1954: Fifth Testing Conference, Dayton, Ohio
Oct. 6–8, 1954: Eighth Alkaline Pulping Conference, Birmingham, Ala.
Oct. 18–21, 1954: Ninth Engineering Conference, Philadelphia, Pa.
Nov. 8–9, 1954: Fibrous Agricultural Residues Conference, Peoria, Ill.
Nov. 17–19, 1954: Fourth Corrugated Container Conference, Savannah, Ga.
May 23–25, 1955: Sixth Coating Conference, Cleveland, Ohio
July 10–23, 1955: Fourth Statistics Course, Madison, Wis.
Sept. 15–17, 1955: Fifth Fundamental Research Conference, Appleton, Wis.
Sept. 19–21, 1955: Second Mechanical Pulping Conference, Poland Spring, Me.
Oct. 5–7, 1955: Fifth Corrugated Containers Conference, Chicago, Ill.
Sept. 28–30, 1955: Sixth Testing Conference, Springfield, Mass.
Oct. 19–21, 1955: Ninth Alkaline Pulping Conference, Chattanooga, Tenn.
Nov. 7–9, 1955: Tenth Engineering Conference, Houston, Tex.
Nov. 14–15, 1955: Tenth Plastics-Paper Conference, Brooklyn, N. Y.

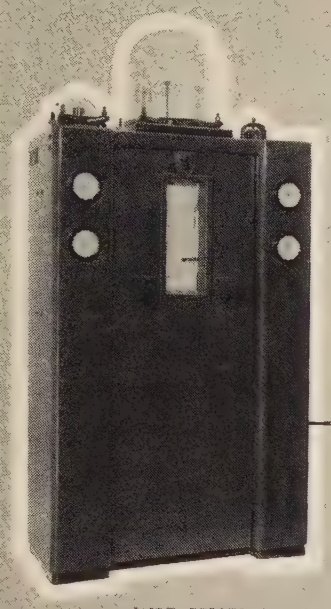
The program for the annual meetings has been arranged each year by the committee and regional chairmen and the secretary. The fall meetings, on the other hand, were arranged largely by strong local committees with the assistance of the secretary and national committee chairmen. With the advent of the functional meeting, the division or committee concerned has been primarily concerned with the program, the National office assisting with the arrangements and such details as are requested by the committee. The Association meetings have done much to promote good will and understanding among the members over the years and have resulted in added efficiency on their part in their services to their respective companies. Sending representatives to the meetings of the Technical Association has yielded high dividends to the pulp and paper industry.

This review will be concluded in the December issue of *Tappi*.

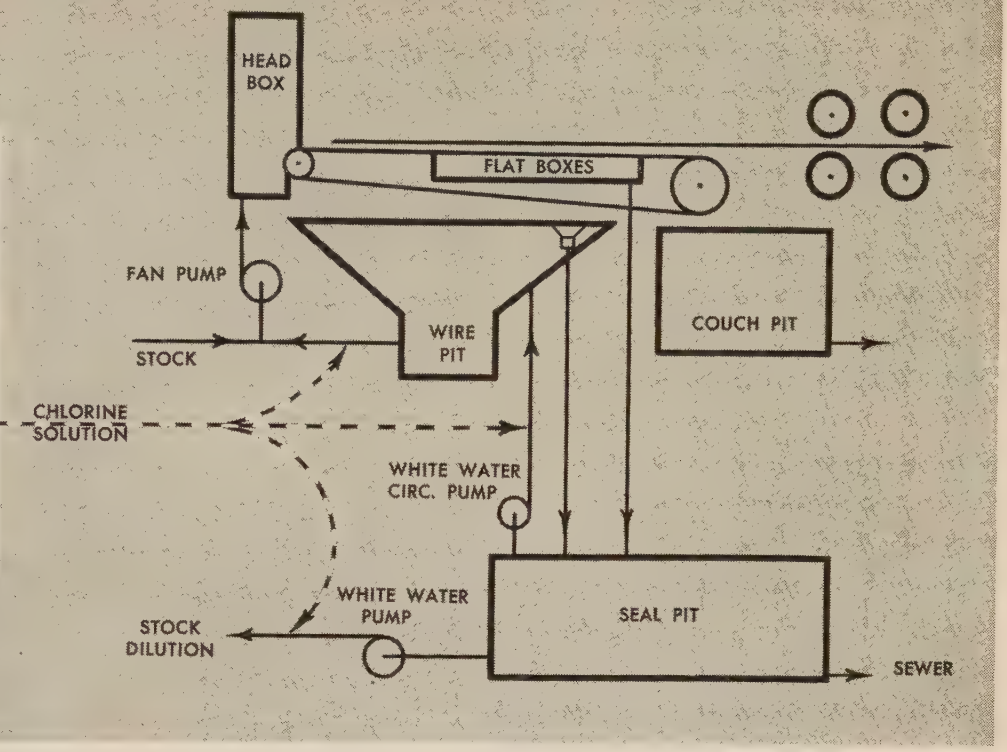
J. J. Thomas, S. D. Warren Co.; Executive Committee (1955–58)

J. C. Wollwage, Kimberly-Clark Corp.; Executive Committee (1955–58)

Slime Control...



W&T SERIES A-664
CHLORINATOR



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Increased reuse of white water in mills multiplies the points at which slime formations can become troublesome. The average mill white water system represents a mixed suspension of organisms, naturally aggressive toward one another, which normally tend to keep one another in a form of numerical balance. When seasonal, physical, mechanical, or chemical changes occur within the system the normal balance between one or more types of organisms is lost and these types will develop at excessive rates to form slime. Wallace and Tiernan slime control systems, using chlorination, will effectively and economically eliminate these slime problems.

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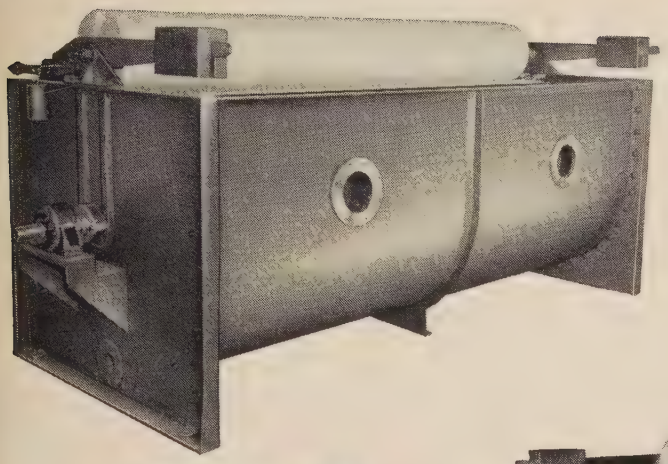
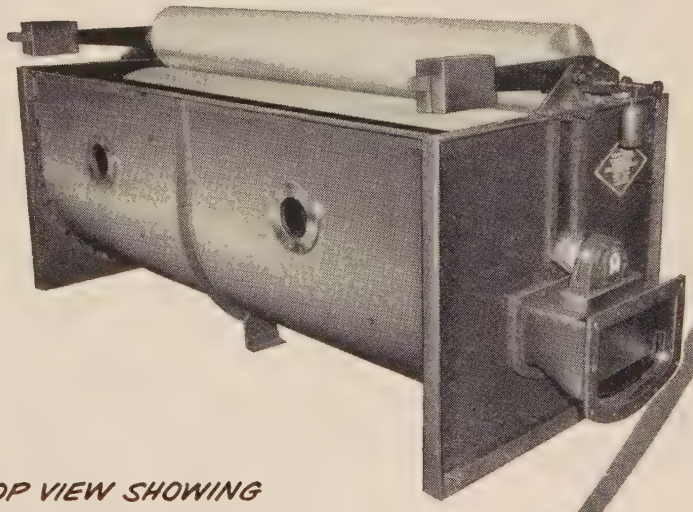
New Orleans, La.
*New York, N. Y.
*Pasadena, Calif.
*Philadelphia, Pa.
*Portland, Ore.
St. Louis, Mo.
*San Francisco, Calif.
Seattle, Wash.

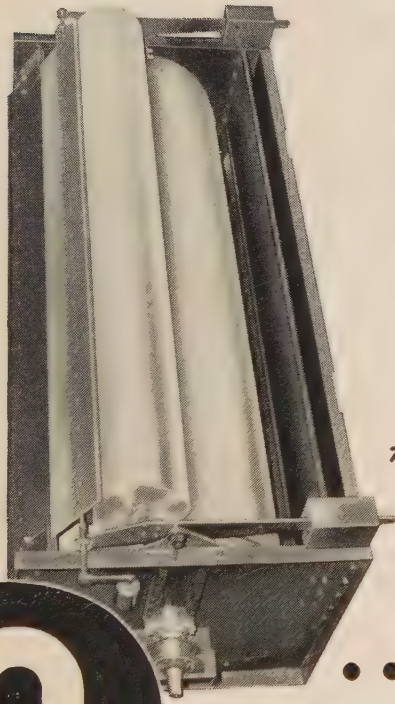
ANY WAY YOU LOOK AT IT...



VIEW OF END AND INTAKE SIDE OF COWAN DECKER

VIEW OF EFFLUENT DISCHARGE END FROM INTAKE SIDE





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85 tons/day — Sulphite
100 tons/day — Kraft

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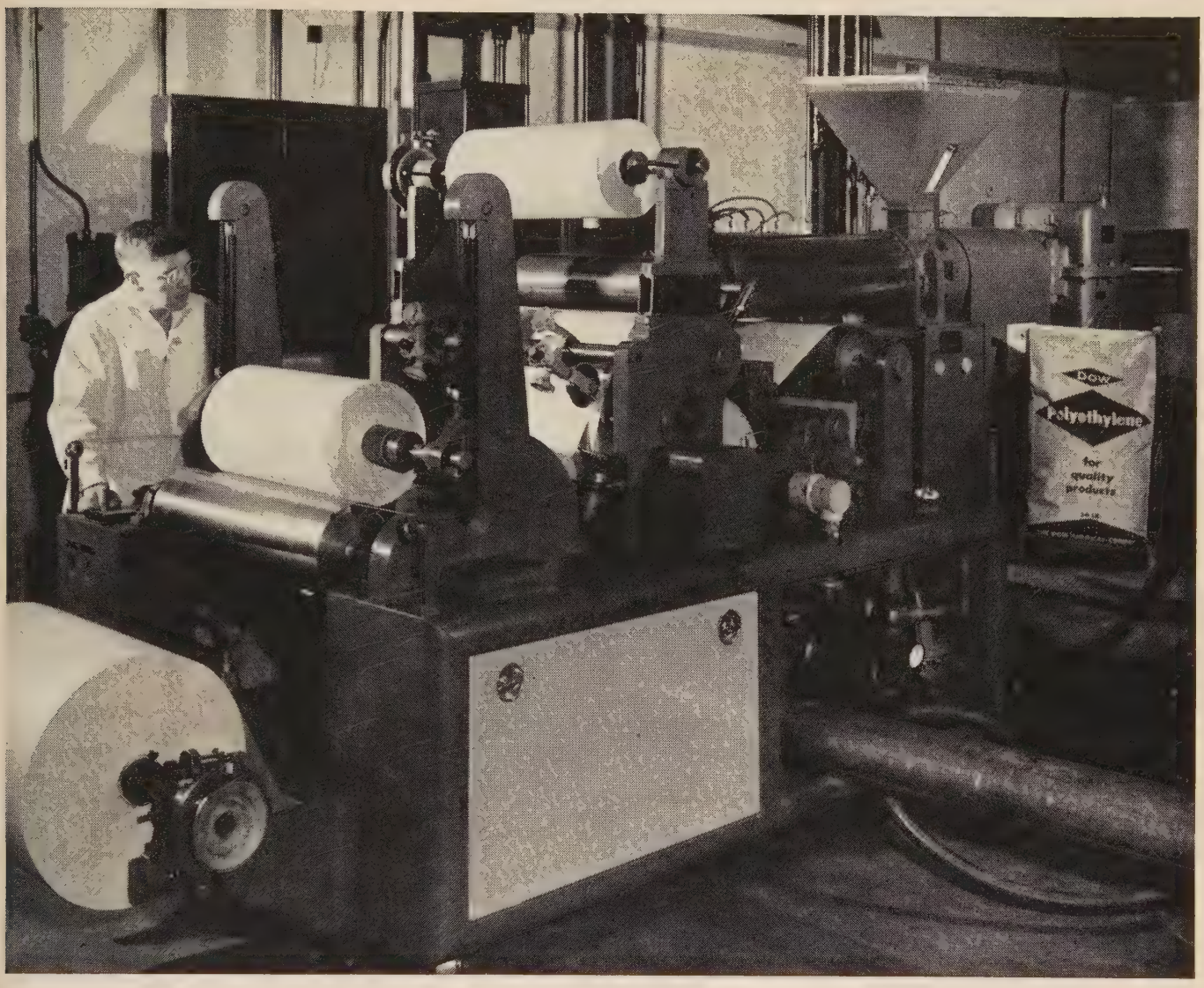
plus this outstanding
customer service



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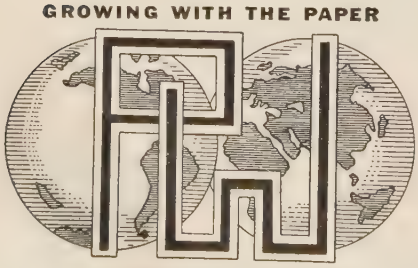

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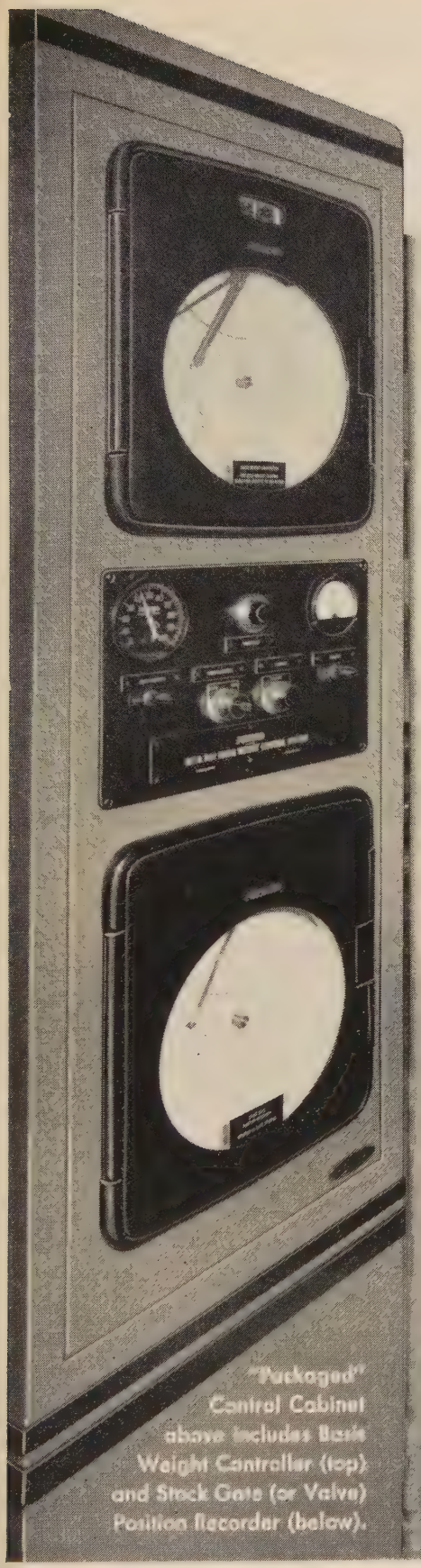
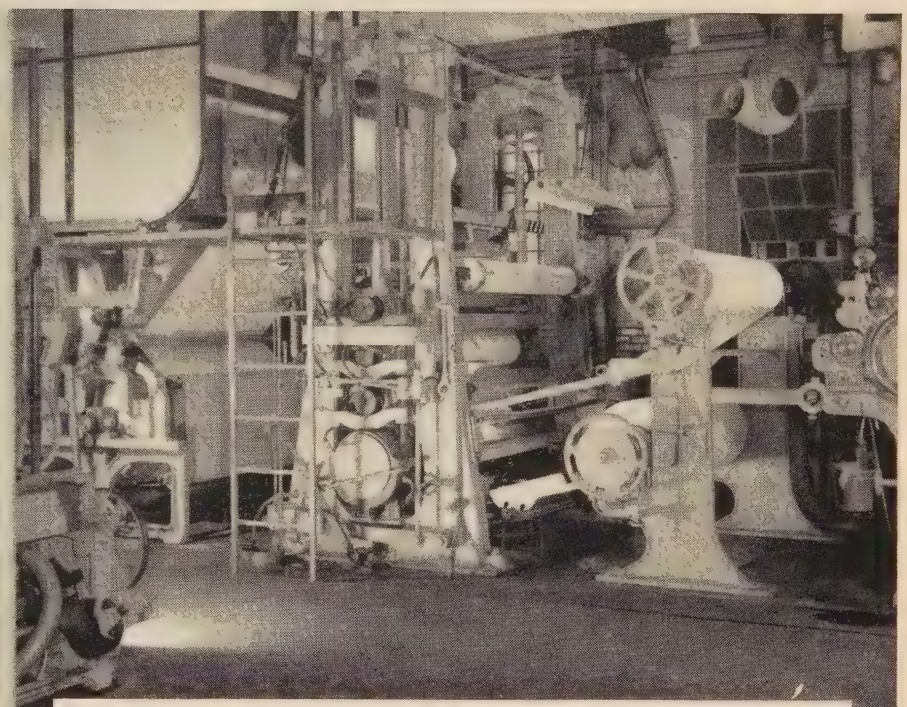


"Packaged" Control Cabinet above includes Basis Weight Controller (top) and Stock Gate (or Valve) Position Recorder (below).



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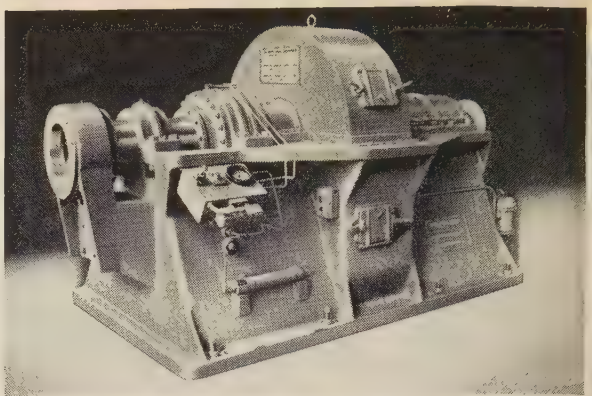

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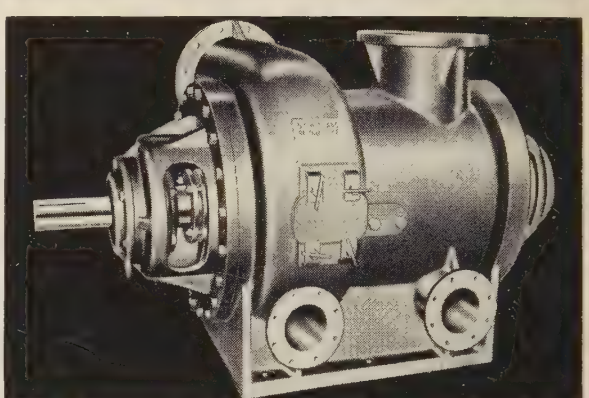

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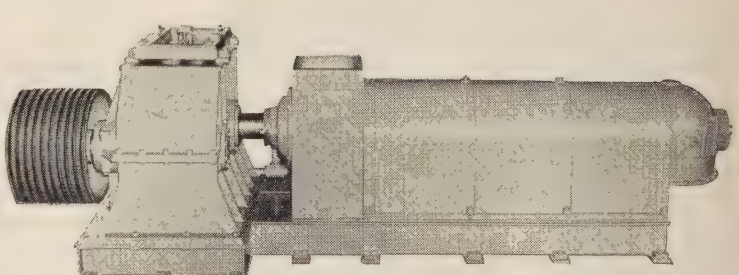

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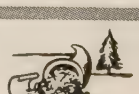

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A Study of Variables Affecting Chlorine Dioxide Bleaching of Semibleached Sulphate Pulp

WARD D. HARRISON and C. R. CALKINS

A study has been made of the effect of a number of bleaching variables upon the brightness and strength of chlorine dioxide bleached southern softwood pine kraft. These studies were run in polyethylene bags (except the pressure series which were run in a specially constructed pressure bleacher). Strength was determined upon handsheets prepared from ball-milled stock. Bleaching conditions of 155°F., 14% consistency, 0.55% chlorine dioxide, 2 hr. time, and atmospheric pressure, were used as a standard. The effect of time, temperature, amount of chlorine dioxide added, pressure, consistency, effect of caustic addition, and initial brightness of the stock were studied. Strength was little affected except by temperatures in excess of 180°F., or by bleaching under alkaline conditions. Increased time over the standard conditions caused only slightly higher increments of brightness. Increased temperature caused slightly increased brightness with an indication of less reversion at higher temperatures. Additional amounts of chlorine dioxide over standard caused a small but significant brightness increase. Pressure and consistency had little effect. Caustic addition decreased brightness in direct proportion to amount added. The initial brightness of the stock had no effect upon final brightness under standard conditions.

THERE is widespread interest in the use of chlorine dioxide for bleaching, with a number of installations already in operation in North America and Europe, and others contemplated.

There have been recent studies and discussions of fundamental reactions of chlorine dioxide and related compounds with cellulosic materials, including Samuelson and Hartler (*1*), Samuelson and Ramsel (*2*), and La-Peze and Dardelet (*3*). Numerous descriptions of the general reactions, problems, and expected results with chlorine dioxide bleaching, including specific methods of application are available. The authors have found Rapson (*4, 5*), Casciani (*6, 7, 8*) (the latter two containing extensive literature surveys and bibliography), Giertz (*9*), and Vincent (*10*) of those more recent references available in English, to be among those valuable for general background. There have been, however, few systematic studies of variables in a given type of chlorine dioxide bleaching operation on a specific pulp. Recently, Rapson (*11*) has given preliminary results of some of his continuing studies of bleaching variables, and undoubtedly there is much unpublished work.

It is the purpose of the authors to present the results of a study of a number of variables on chlorine dioxide bleaching of commercially manufactured conventional five-staged semibleached southern pine kraft. The general conditions and ranges of these studies were adapted from knowledge of the Riegel Carolina Corp., chlorine dioxide bleaching operation at Acme, N.C. Descriptions of this plant and its operation have been published by Harrison (*12, 13*), Wiley (*14*), and Dailey (*15*).

WARD D. HARRISON, Vice-President in Charge of Production, and C. R. CALKINS, Director of Research, Riegel Paper Corp., Milford, N. J.

PROCEDURES

For all experiments (except initial brightness series) a single bale of commercially manufactured five-stage bleached southern pine kraft of 70 G.E. brightness obtained from Riegel Carolina Corp. was used.

Stock Preparation

Distilled water was used throughout, except where noted. Stock was broken up in a TAPPI disintegrator, drained on a stainless steel screen, placed in a cheese cloth bag and pressed to about 70% moisture content, shredded by hand, mixed, placed in a large polyethylene bag and allowed to come to equilibrium, and its moisture content determined.

Chlorine Dioxide Solution Preparation

Chlorine dioxide solution was prepared by mixing chlorine water and sodium chlorite solutions, in the approximate ratio of 2.55 grams sodium chlorite to 1 gram chlorine. This was analyzed according to the method described by Harrison (*13*), and corrected by addition of chlorine water or sodium chlorite as needed until only chlorine dioxide was present by analysis.

Preparation of Individual Bleaches

The polyethylene bag technique, developed by the Forest Products Laboratory, was used, except for pressure studies. In each of the several 12 by 18 in. polyethylene bags comprising the series under study, 270 grams (moisture-free basis) of stock were placed. The exact weight of each component needed was added, and sufficient water added to obtain the desired consistency. Each bag was then sealed with a heavy rubber band. Each bag was preheated in a hot water bath at the desired temperature for approximately 30 min. The bag was removed and the chlorine dioxide solution added (on the pH series the sodium hydroxide solution was also added at this point) and the bag quickly closed. Bleaching time started at this point.

After careful "kneading" to mix the solutions and pulp, the bag was returned to the constant temperature water bath at the desired temperature for the duration of the bleach. This bath, electrically heated and controlled, held the temperature within ±3°F. of the desired temperature.

Preparation of Stock for Strength Tests

At the completion of the bleach the bag was removed

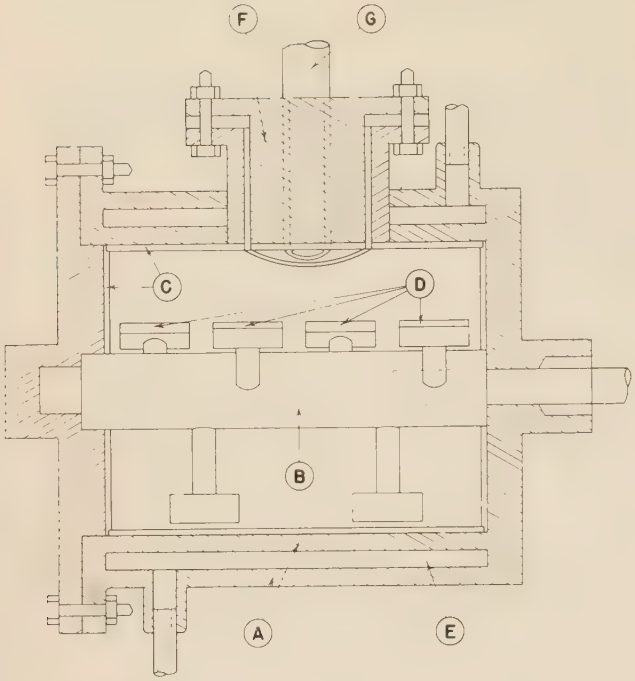

Fig. 1. Sectional view of pressure bleacher

from the bath and a 5-gram brightness sample immediately removed and treated as described below.

The stock for strength determinations was immediately placed on a stainless steel screen and washed with process water until free of the characteristic yellow color of chlorine dioxide. The bleach was "killed" using sodium thiosulphate and washed thoroughly. Ball mill tests were run on this slush stock within 24 hr.

Preparation and Testing of Brightness Sheets

An approximately 5-gram sample was placed in 250 ml. of distilled water, agitated, and filtered on a Buchner funnel, washed with three 400-ml. portions of distilled water, removed from the filter paper, broken up in 250 ml. of distilled water and filtered, washed with three 400-ml. portions of distilled water, removed from the filter paper, broken up and allowed to stand for 3 min. in 400 ml. of distilled water, filtered, washed with 400 ml. of distilled water, removed from the filter paper, and dispersed in 2 liters of distilled water. Two sheets were formed and air dried according to TAPPI Standard T 218 m-48. Brightnesses were run at several time intervals, plotted against time, and reported at 24 hr. The tabs were rechecked approximately 2 months later.

Physical Testing of Bleached Stocks

A ball mill test, meeting the requirements of TAPPI Standard T 224 m-45, was run in duplicate on each bleach. Samples were taken at regular intervals and hand-sheets prepared according to TAPPI Standard T 205 m-53. These were tested and reported in accordance with TAPPI Standard T 220 m-53. Tests were plotted against Canadian Standard freeness and reported at regular freeness intervals.

Initial Brightness Series

Pulps of four brightness levels were used. One was the standard pulp (70 G.E. brightness). One was an otherwise similar bale (66 G.E. brightness). Two were prepared at G.E. brightness levels of 72 and 77, by bleaching each of the above pulps with 0.1% hypochlorite at 8% consistency, 100°F, for 10 and 30 min., respectively. Each bleach was "killed" with dilute sodium bisulphite and thoroughly washed. This work was all done with process water.

Pressure Bleaches

These bleaches were run in a special bleacher illustrated in detail in Fig. 1. It consists of a double wall steel cylinder (A) with agitator (B), completely lined with 1/4-in. thick polyvinyl chloride (C). The agitator is Teflon covered steel with Teflon paddles (D).

Auxiliary equipment for the pressure bleacher include drive and gear reduction system for the agitator, a steam heated water reservoir, and pump and various fittings necessary for access to the bleacher during operation. The water reservoir, provided with a pump to circulate water through the jacket of the bleacher (E), was used to control the temperature in the bleacher. The access port plug (F) to the main chamber is so shaped that a smooth inner surface results when it is in place. The plug is fitted with a pipe (G) for chemical addition. Two valves are provided to permit chemical addition under pressure. A tee is provided below the lower valve for pressure control by compressed air. All pipes and fittings are made of Uscolite except the steel air line.

The following procedure was used. Two hundred and seventy grams (moisture-free basis) stock were placed in the bleacher along with the desired amount of distilled water less 100 ml. The port plug was bolted in place and the agitation started. The water reservoir was heated to 10°F. above the temperature desired in the bleacher, and circulated through the shell of the bleacher. Pressure inside the bleacher was brought to the desired level by use of compressed air. After the stock reached the desired temperature the agitator was stopped and the pressure released. The chlorine

Table I. Correlation of Standards
Five "standard" bleaches made on same day[a]

	Min.	*Av.*	*Max.*	*Span*
Bursting strength, p.s.i.				
600 ml. freeness	46	47.7	50	4
500 ml. freeness	48	49.5	51	3
400 ml. freeness	49	51.0	53	4
300 ml. freeness	50	51.1	54	4
200 ml. freeness	49	51.3	55	6
100 ml. freeness	49	50.6	52	3
Tear, g.				
600 ml. freeness	67	70.0	75	8
500 ml. freeness	60	62.6	65	5
400 ml. freeness	51	55.9	61	10
300 ml. freeness	47	52.0	56	9
200 ml. freeness	43	48.6	54	11
100 ml. freeness	40	43.4	51	11
Brightness				
12 hr.	86.0	86.2	86.4	0.4
24 hr.	86.0	86.2	86.5	0.5
48 hr.	86.0	86.0	86.1	0.1
72 hr.	85.7	85.9	86.2	0.5
2 months	82.9	83.5	83.9	1.0

[a] Standard conditions for all bleaches were:
(a) Time—2 hr.
(b) % ClO_2 (fiber basis)—0.55.
(c) % Consistency—14.
(d) Temperature—155°F.
(e) Pressure—atmospheric.
(f) Terminal pH—2.8 range.
(g) Initial brightness—69.9.

Table II. Correlation of Standards—Pertinent Data

Five "standard" bleaches made on same day[a]

	300 ml. Freeness				
	Bursting strength, p.s.i.		Tear, g.		Brightness
	Orig.	Dup.	Orig.	Dup.	24 hr.
Bleach no. PB-11	51	51	56	48	86.0
Bleach no. PB-12	51	54	56	51	86.0
Bleach no. PB-13	51	50	53	47	86.3
Bleach no. PB-14	51	50	53	51	86.1
Bleach no. PB-15	51	51	52	53	86.5
Minimum	50		47		86.0
Average	51.1		52.0		86.2
Maximum	54		56		86.5
Span	4		9		0.5

[a] Standard conditions for all bleaches were:
(a) Time—2 hr.
(b) % ClO_2 (fiber basis)—0.55.
(c) % Consistency—14.
(d) Temperature—155°F.
(e) Pressure—atmospheric.
(f) Terminal pH—2.8 range.
(g) Initial brightness—69.9.

dioxide solution was added, all valves were closed, the agitator started, and the pressure again brought to the desired level. Addition of chlorine dioxide solution dropped the temperature approximately 10°F. and the bleach temperature was controlled at the desired temperature by intermittent operation of circulating pump.

STUDY OF REPRODUCIBILITY

The reproducibility of the techniques used was checked by running five bleaches at standard conditions (0.55% chlorine dioxide, 14% consistency, 155°F., 2 hr. time, atmospheric pressure) in a single day. Data are given in Table I, from which the data of Table II are extracted. (Strength data at 300 ml. Canadian Standard freeness has been used throughout as representative of over-all strength.)

Each time a series of bleaches was run, a standard was repeated. The reproducibility when all these data (which include variability due to preparation of new batches of pulp, new chlorine dioxide solutions, and unknown residual variations) are included, is found in Tables III and IV.

These data indicate the ranges to be expected with individual bleaches and single ball mills on each bleach. Ball mills in this work were run in duplicate. Past work in our ball mills has shown the reproducibility, found in Table V, for duplicate ball mills of unbleached kraft and bleached sulphite, respectively. These data indicate that our strength tests (in duplicate) as reported at 300 ml. Canadian Standard freeness are accurate within ±4% for bursting strength and ±5% for tear. Brightness results are believed accurate to ±1 unit.

Table III. Correlation of Standards

Eleven "standard" bleaches made on 7 separate days[a]

	Min.	Av.	Max.	Span
Bursting strength, p.s.i.				
600 ml. freeness	46	48.5	51	5
500 ml. freeness	48	50.4	53	5
400 ml. freeness	49	52.0	55	6
300 ml. freeness	50	52.2	57	7
200 ml. freeness	49	52.1	58	9
100 ml. freeness	48	51.5	57	9
Tear, g.				
600 ml. freeness	63	68.8	75	12
500 ml. freeness	59	62.4	67	8
400 ml. freeness	51	56.4	61	10
300 ml. freeness	47	52.5	56	9
200 ml. freeness	43	48.8	54	11
100 ml. freeness	37	42.5	51	14
Brightness				
12 hr.	85.9	87.0	88.0	2.1
24 hr.	86.0	86.7	87.8	1.8
48 hr.	86.0	86.4	87.4	1.4
2 months	82.9	83.6	84.4	1.5

[a] Standard conditions for all bleaches were:
(a) Time—2 hr.
(b) % ClO_2 (fiber basis)—0.55.
(c) % Consistency—14.
(d) Temperature—155°F.
(e) Pressure—atmospheric.
(f) Terminal pH—2.8 range.
(g) Initial brightness—69.0–72.3.

EFFECT OF TIME

Complete data are found in Table VI. Under otherwise standard bleaching conditions, brightness increases rapidly at first, then at a slower rate. Strength is little affected (Fig. 2). No drop in brightness up to 5 hr. is noted, possibly due to the fact that the chlorine dioxide is not exhausted under these conditions.

EFFECT OF AMOUNT OF CHLORINE DIOXIDE ADDED

When the amount of chlorine dioxide added was varied the brightness rose rapidly up to 0.55% addition and then climbed only slightly (Figure 3). Complete data are in Table VII. This indicates that additional chlorine dioxide beyond our standard had only a minor effect upon brightness. Bursting strength was unaffected while tear appears to rise slightly.

Table IV. Correlation of Standards—Pertinent Data

Eleven "standard" bleaches made on 7 separate days[a]

	Date made	Bursting strength, p.s.i. 300 ml. freeness Orig.	Bursting strength, p.s.i. 300 ml. freeness Dup.	Tear, g. 300 ml. freeness Orig.	Tear, g. 300 ml. freeness Dup.	Brightness 24 hr.
Bleach no. PB-5	1/22	56	..	55	..	87.8
Bleach no. PB-7	1/23	57	..	52	..	87.4
Bleach no. PB-11	1/25	51	51	56	48	86.0
Bleach no. PB-12	1/25	51	54	56	51	86.0
Bleach no. PB-13	1/25	51	50	53	47	86.3
Bleach no. PB-14	1/25	51	50	53	51	86.1
Bleach no. PB-15	1/25	51	51	52	53	86.5
Bleach no. PB-18	1/26	55	52	52	51	87.4
Bleach no. PB-21	1/27	53	51	51	51	87.5
Bleach no. PB-27	1/29	55	53	52	55	86.6
Bleach no. PB-38	2/2	50	51	56	56	86.5
Minimum		50		47		86.0
Average		52.2		52.5		86.7
Maximum		57		56		87.8
Span		7		9		1.8

[a] Standard conditions for all bleaches were:
(a) Time—2hr.
(b) % ClO_2 (fiber basis)—0.55.
(c) % Consistency—14.
(d) Temperature—155°F.
(e) Pressure—atmospheric.
(f) Terminal pH—2.8 range.
(g) Initial brightness—69.0–72.3.

Table V. Standard Ball Mill Variation

Two Sigma Reproducibility Limits; Duplicate Ball Mill Determinations (2σ limits—two operators)

	Softwood kraft			*Softwood sulphite*		
	Min.	*Max.*	*Range*[a]	*Min.*	*Max.*	*Range*[a]
Bursting strength, p.s.i.						
600 ml. freeness	61	72	5.2	..	..	...
500 ml. freeness	65	75	4.7	42	47	2.5
400 ml. freeness	69	77	4.2	46	49	1.4
300 ml. freeness	69	76	3.5	48	51	1.1
200 ml. freeness	67	76	4.4	49	54	2.7
100 ml. freeness	64	75	5.8	50	53	1.3
Tear, g.						
600 ml. freeness	65	76	5.8	..	..	...
500 ml. freeness	59	68	4.5	38	48	4.9
400 ml. freeness	51	63	5.8	37	42	2.7
300 ml. freeness	48	55	3.9	35	40	2.1
200 ml. freeness	43	50	3.7	32	36	2.1
100 ml. freeness	37	46	4.1	29	33	2.0

[a] This is $\pm 2\sigma$.

EFFECT OF CONSISTENCY

The consistency of otherwise standard bleaches was varied from 8 to 20% (Table VIII and Fig. 4). A rise in brightness with increasing consistency was noted

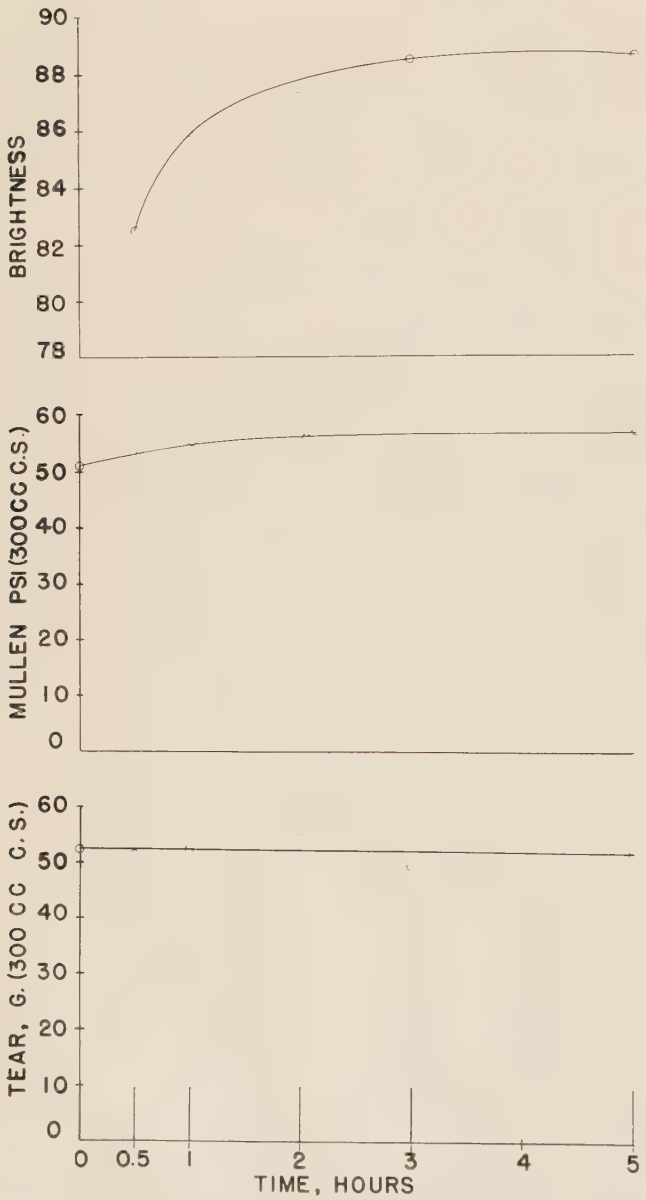

Fig. 2. Effect of time on bursting strength, tear, and brightness

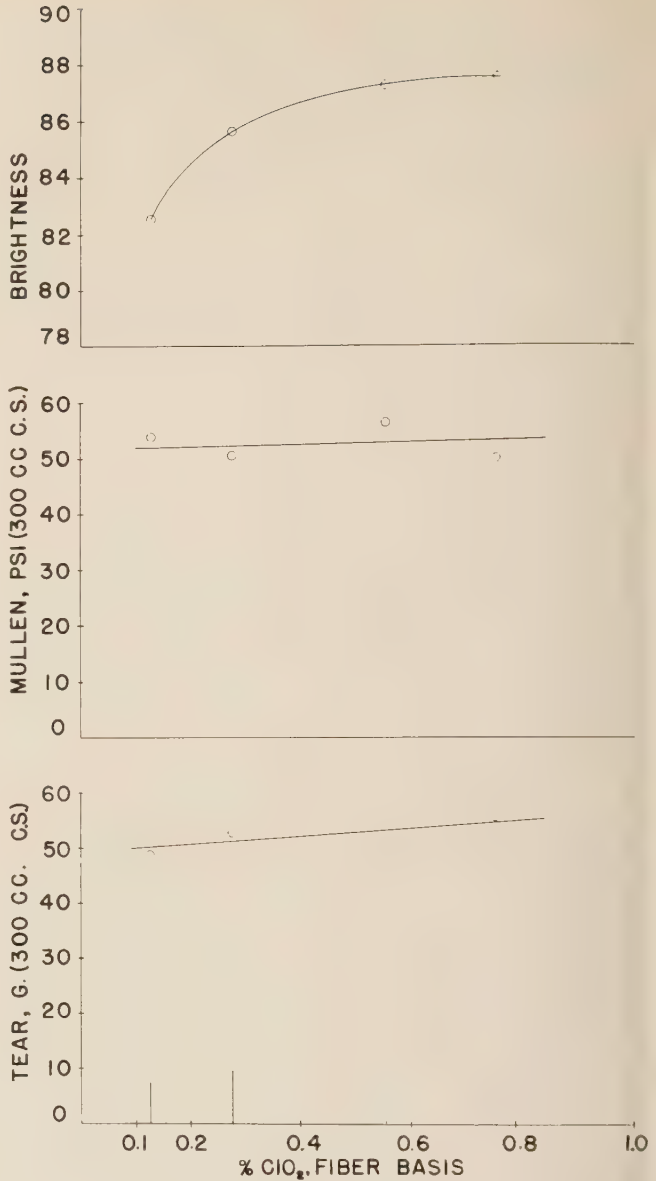

Fig. 3. Effect of ClO_2 concentration on bursting strength, tear, and brightness

Table VI. Effect of Time on Bursting Strength, Tear, and Brightness of Five-Stage Bleached Softwood Kraft Bleached with Chlorine Dioxide

	Bleaching time, hr.					
	0[a]	*1/2*	*1*	*2*[b]	*3*	*5*
Bursting strength, p.s.i.						
600 ml. freeness	48	52	50	50	47	49
500 ml. freeness	50	54	53	53	49	53
400 ml. freeness	51	56	55	55	51	55
300 ml. freeness	51	53	55	56	51	57
200 ml. freeness	51	52	54	57	51	59
100 ml. freeness	52	55	53	55	51	59
Tear, g.						
600 ml. freeness	70	64	67	68	65	69
500 ml. freeness	62	59	62	63	59	57
400 ml. freeness	56	53	57	59	52	54
300 ml. freeness	52	51	52	55	49	51
200 ml. freeness	48	50	47	51	45	49
100 ml. freeness	42	43	41	43	39	43
Brightness						
24 hr.	69.0	82.5	86.1	87.3	87.6	87.8
2 months	69.6	78.9	83.6	83.0	85.5	85.7

[a] Base stock.

[b] Two-hour bleaching time is "standard." Other "standard" conditions for all five bleaches:

(a) % ClO_2 (fiber basis)—0.55.
(b) % Consistency—14.
(c) Temperature—155°F.
(d) Pressure—atmospheric.
(e) Terminal pH—2.8 range.
(f) Initial brightness—69.0.

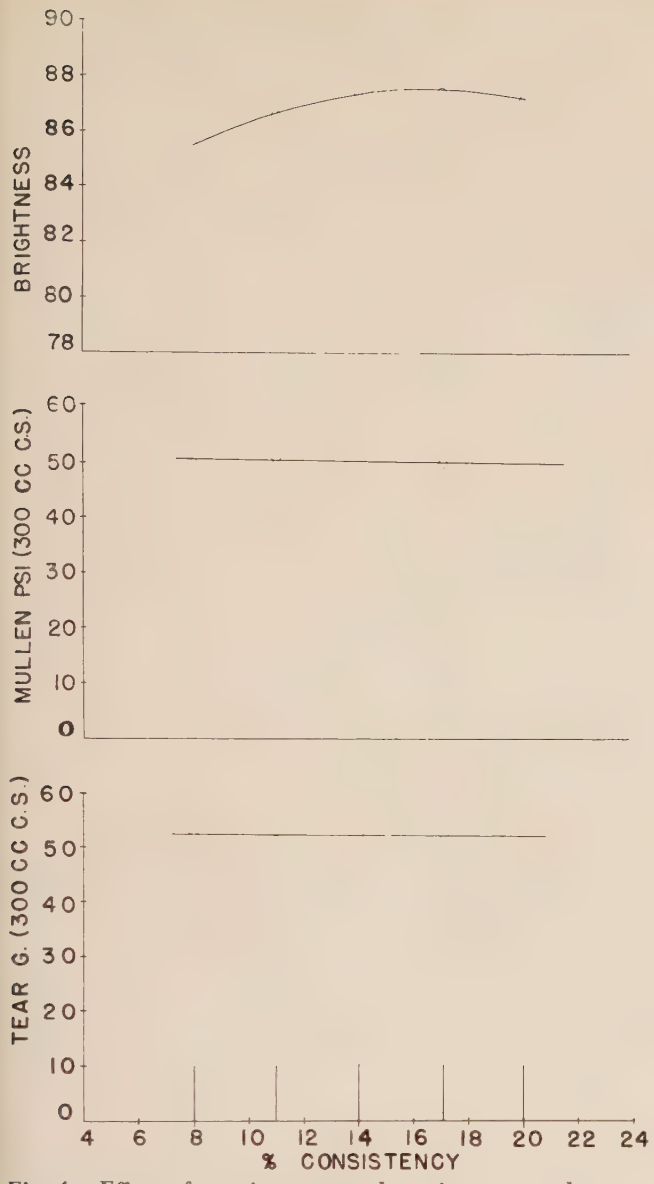

Fig. 4. Effect of consistency on bursting strength, tear, and brightness

Table VII. Effect of ClO_2 Concentration on Bursting Strength, Tear, and Brightness of Five-Stage Bleached Softwood Kraft Bleached with Chlorine Dioxide

	% ClO_2, fiber basis			
	0.125	0.275	0.550[a]	0.750
Bursting strength, p.s.i.				
600 ml. freeness	48	47	50	48
500 ml. freeness	52	49	53	49
400 ml. freeness	56	51	55	50
300 ml. freeness	55	52	57	51
200 ml. freeness	53	53	58	53
100 ml. freeness	53	51	57	53
Tear, g.				
600 ml. freeness	65	69	67	71
500 ml. freeness	59	62	62	65
400 ml. freeness	54	57	58	61
300 ml. freeness	49	53	52	56
200 ml. freeness	45	49	46	51
100 ml. freeness	39	43	41	42
Brightness				
24 hr.	82.6	85.8	87.4	87.7
2 months	79.8	82.8	83.7	85.7

[a] 0.55% ClO_2 is "standard." Other "standard" conditions for all four bleaches:

(a) Time—2 hrs.
(b) % Consistency—14.
(c) Temperature—155°F.
(d) Pressure—atmospheric.
(e) Terminal pH—2.8 range.
(f) Initial brightness—69.9.

Table VIII. Effect of Consistency on Bursting Strength, Tear and Brightness of Five-Stage Bleached Softwood Kraft Bleached With Chlorine Dioxide

	% Consistency				
	8	11	14[a]	17	20
Bursting strength, p.s.i.					
600 ml. freeness	47	47	49	47	44
500 ml. freeness	48	49	51	48	46
400 ml. freeness	49	51	52	50	47
300 ml. freeness	50	51	54	50	48
200 ml. freeness	51	50	54	51	50
100 ml. freeness	54	54	53	53	51
Tear, g.					
600 ml. freeness	68	66	64	66	65
500 ml. freeness	62	60	60	60	58
400 ml. freeness	55	54	55	54	53
300 ml. freeness	52	51	52	52	49
200 ml. freeness	50	47	48	49	45
100 ml. freeness	42	40	39	45	39
Brightness					
24 hr.	85.5	86.6	87.4	87.5	87.2
2 months	82.6	84.0	84.4	84.5	84.5

[a] 14% Consistency is "standard." Other "standard" conditions for all five bleaches:

(a) Time—2 hr.
(b) % ClO_2 (fiber basis)—0.55.
(c) Temperature—155°F.
(d) Pressure—atmospheric.
(e) Terminal pH—2.8 range.
(f) Initial brightness—69.9.

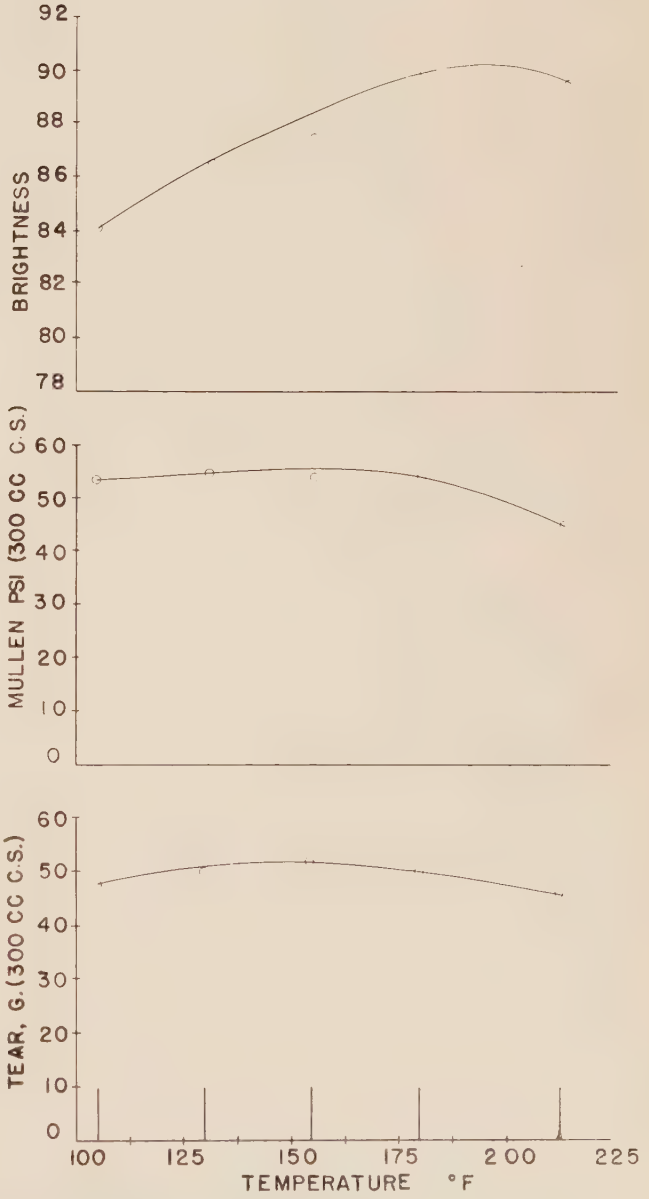

Fig. 5. Effect of temperature on bursting strength, tear, and brightness

leveling off at 14%, and apparently dropping slightly at 20%. The latter noted slight drop may possibly be due to poorer mixing at these consistencies or to lack of solubility of chlorine dioxide at these lower water ratios and subsequent loss. The latter may be questioned, since the bags were tightly closed. Even so, some loss may have occurred at addition. Strength was little affected.

EFFECT OF TEMPERATURE

When temperature was varied from 100 to 212°F., the brightness rose steadily up to 180°F., and then leveled off or fell off slightly at the highest temperature (Table IX and Fig. 5). There was little effect upon tear, but bursting strength dropped off significantly at the highest temperature. The reaction rate is appreciably increased with increasing temperature, and it is possible that exhaustion occurred at the highest temperature with attendant reversion. Since the exact nature and degree of bleaching action may be different at the different temperatures it is possible that different reaction products are formed, which cause a leveling or lowering of brightness.

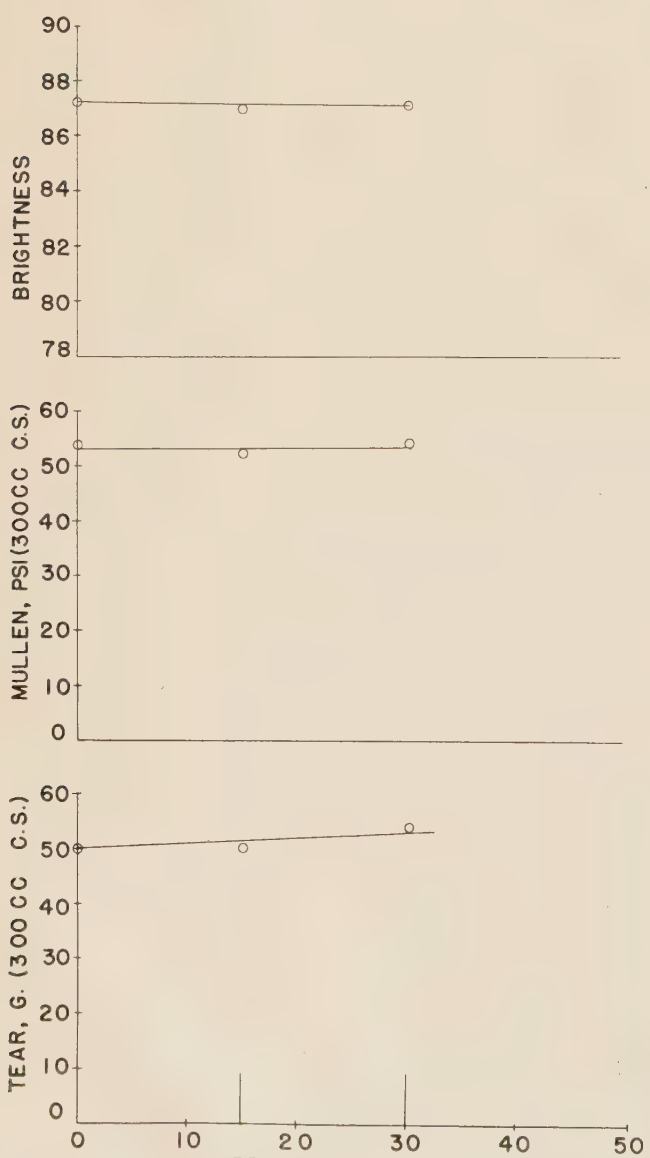

Fig. 6. Effect of pressure on bursting strength, tear, and brightness

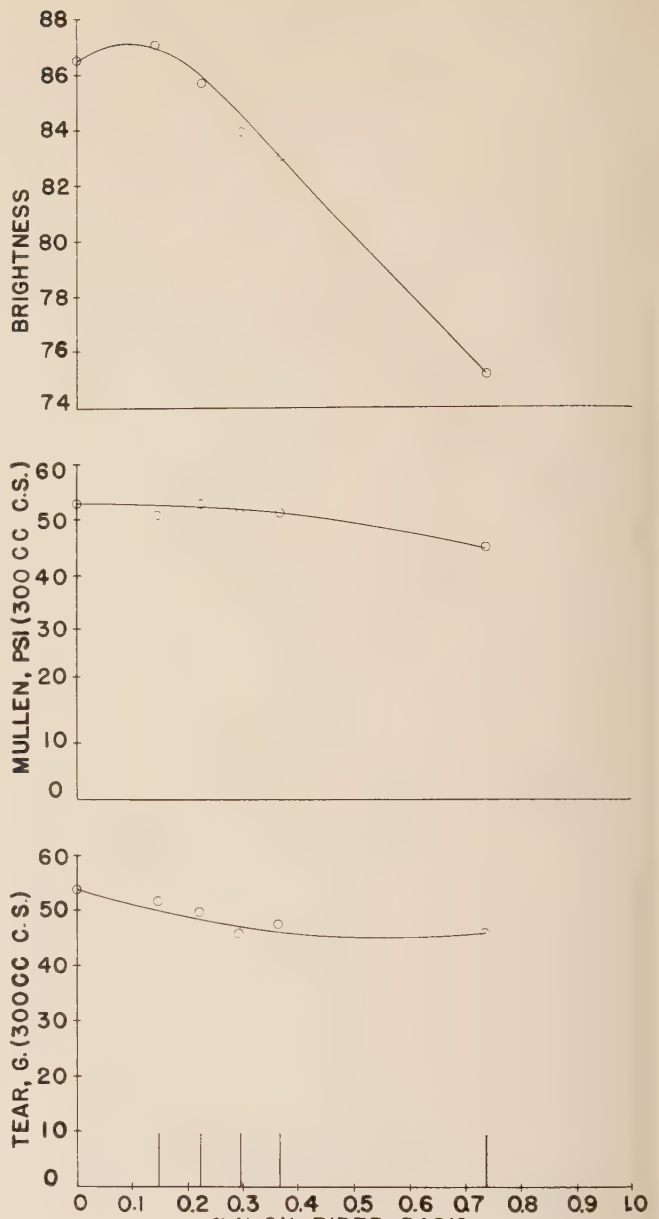

Fig. 7. Effect of NaOH addition on bursting strength, tear, and brightness

Table IX. Effect of Temperature on Bursting Strength, Tear, and Brightness of Five-Stage Bleached Softwood Kraft Bleached with Chlorine Dioxide

	Bleaching temperature, °F.				
	105	*130*	*155*[a]	*180*	*212*
Bursting strength, p.s.i.					
600 ml. freeness	51	50	48	48	44
500 ml. freeness	52	54	50	50	44
400 ml. freeness	54	56	52	52	45
300 ml. freeness	54	55	52	54	45
200 ml. freeness	56	54	50	56	44
100 ml. freeness	56	54	49	56	46
Tear, g.					
600 ml. freeness	64	67	66	66	62
500 ml. freeness	59	59	60	60	56
400 ml. freeness	53	52	56	56	50
300 ml. freeness	48	50	51	50	46
200 ml. freeness	44	46	46	46	42
100 ml. freeness	38	40	40	40	40
Brightness					
24 hr.	84.1	86.6	87.5	90.0	89.6
2 months	79.7	81.7	83.6	86.6	88.2

[a] 155°F. is "standard" temperature. Other "standard" conditions for all five bleaches:
(a) Time—2 hr.
(b) % ClO_2 (fiber basis)—0.55.
(c) % Consistency—14.
(d) Pressure—atmospheric.
(e) Terminal pH—2.8 range.
(f) Initial brightness—70.7.

Table X. Effect of Pressure on Bursting Strength, Tear, and Brightness of Five-Stage Bleached Softwood Kraft Bleached With Chlorine Dioxide

	Pressure, p.s.i.g.				
	0	15[a]	15[a]	15[a]	30
Bursting strength, p.s.i.					
600 ml. freeness	48	49	48	46	46
500 ml. freeness	51	52	50	48	50
400 ml. freeness	52	54	51	48	52
300 ml. freeness	54	54	52	50	54
200 ml. freeness	52	54	52	49	56
100 ml. freeness	50	48	53	49	56
Tear, g.					
600 ml. freeness	68	75	65	68	69
500 ml. freeness	62	66	60	61	64
400 ml. freeness	56	57	53	55	59
300 ml. freeness	50	51	48	50	54
200 ml. freeness	45	44	45	44	48
100 ml. freeness	40	40	40	39	42
Brightness					
24 hr.	87.3	87.0	87.1	87.3	87.2
2 months	84.5	84.6	85.5	84.6	84.0

[a] Three bleaches made to obtain correlation. Other conditions for all bleaches were:
(a) Time—2hr.
(b) % ClO_2 (fiber basis)—0.55.
(c) % Consistency—14.
(d) Temperature—155°F.
(e) Terminal pH—2.8 range.
(f) Initial brightness—72.0.

Table XI. Effect of NaOH Addition on Bursting Strength, Tear, and Brightness of Five-Stage Bleached Softwood Kraft Bleached With Chlorine Dioxide

	1.0% NaOH, ml.					
	0[a]	40	60	80	100	200
Terminal pH	2.8	4.1	6.3	6.0	6.7	11.4
Bursting, strength, p.s.i.						
600 ml. freeness	50	49	48	48	47	44
500 ml. freeness	52	51	51	52	49	45
400 ml. freeness	54	52	54	52	50	46
300 ml. freeness	54	52	54	52	52	46
200 ml. freeness	54	52	54	52	50	46
100 ml. freeness	54	54	54	52	50	46
Tear, g.						
600 ml. freeness	68	66	64	60	60	58
500 ml. freeness	62	60	60	55	56	54
400 ml. freeness	56	54	54	51	52	49
300 ml. freeness	54	52	50	46	48	46
200 ml. freeness	51	48	46	42	43	41
100 ml. freeness	42	42	41	36	38	37
Brightness						
24 hr.	86.6	87.2	85.8	84.0	83.1	75.2
2 months	83.4	83.9	82.1	81.0	80.4	73.5

[a] Terminal pH of 2.8 (no NaOH addition) is "standard." Other "standard" conditions for all six bleaches were:
(a) Time—2 hr.
(b) % ClO_2 (fiber basis)—0.55.
(c) % Consistency—14.
(d) Temperature—155°F.
(e) Pressure—atmospheric.
(f) Initial brightness—72.3.

EFFECT OF PRESSURE

Pressure between 0 and 30 p.s.i. (gage) had no significant effect upon brightness or strength (Table X and Fig. 6). The reaction is, in this range and under these conditions at least, completely independent of pressure.

EFFECT OF CAUSTIC ADDITION

Varied amounts of sodium hydroxide were added, at the start of otherwise standard bleaches. Besides brightness and strength data, the terminal pH of the bleach liquor was measured. A slight addition of caustic caused a slight increase in brightness, but additional increments caused a drop in final brightness linearly with caustic addition (Table XI and Fig. 7). Strength was little affected, except at a highly alkaline pH. The optimum pH for chlorine dioxide bleaching as regards brightness is known to be somewhat on the acid side. In this work, obviously, the pH started originally on the alkaline side, and then gradually became acidic due to reaction products formed. Since the kind, amount, mechanism, and rate of formation of these products vary with the pH of the bleaching system it is futile to speculate on the basis of this limited data. This applied study shows that, except possibly in small amounts, addition of caustic is detrimental to brightness, and in excessive amounts, to strength.

EFFECT OF INITIAL BRIGHTNESS OF STOCK

Stocks of four different initial brightnesses, prepared as previously noted, were bleached in the standard manner. The brightness of each stock came to the same level, and, within the limits of our procedures, the strength was unaffected (Table XII). Within these general limits at least, and with an apparently sufficient quantity of chlorine dioxide, and time of reaction, the original brightness is not particularly important. This illustrates the versatility of chlorine dioxide as a bleaching agent, and the apparently specific nature of its attack upon the coloring materials of semibleached kraft pulps. A more detailed study might reveal differences in consumption or rate of bleaching, but given the conditions of these experiments, the original differences had insignificant effects.

OBSERVATIONS OF REVERSION

Since reversion is such an important operating prob-

Table XII. Effect of Initial Brightness on Bursting Strength Tear, and Final Brightness of Multiple-Stage Bleached Softwood Kraft Bleached with Chlorine Dioxide

	Initial brightness							
	66		69		72		77	
	Orig.[a]	Final[c]	Orig.[b]	Final[c]	Orig.[a]	Final[c]	Orig.[b]	Final[c]
Bursting strength, p.s.i.								
600 ml. freeness	48	48	48	49	46	52	48	49
500 ml. freeness	51	50	50	50	48	56	51	52
400 ml. freeness	52	52	51	52	48	57	53	55
300 ml. freeness	54	52	51	50	48	56	54	54
200 ml. freeness	54	52	51	49	48	56	54	55
100 ml. freeness	50	52	52	51	50	56	52	54
Tear, g.								
600 ml. freeness	68	60	70	73	68	66	67	65
500 ml. freeness	62	56	62	66	62	59	61	60
400 ml. freeness	56	52	56	60	56	54	56	56
300 ml. freeness	52	48	52	56	52	51	52	52
200 ml. freeness	47	44	48	52	48	47	50	47
100 ml. freeness	40	40	42	44	42	42	42	41
Brightness								
24 hr.	66.0	86.8	69.0	86.5	72.0	86.7	76.7	86.5
2 months	66.7	83.6	69.7	84.0	72.6	84.4	75.3	84.0

[a] Five-stage mill bleach.
[b] Five-stage mill bleach plus lab. hypo-caustic bleach.
[c] Standard conditions for all four bleaches were:
(a) Time—2 hr.
(b) % ClO_2 (fiber basis)—0.55.
(c) % Consistency—14.
(d) Temperature—155°F.
(e) Pressure—atmospheric.
(f) Terminal pH—2.8 range.

lem the effect of these various treatments upon it is of interest. All brightness tabs were retested approximately 2 months later. With the exception of the temperature series, the amount of reversion showed no particular relationship to the studied variables; only in the case of the very low brightness samples was reversion significantly less. This is not an unexpected result, and can be explained by the increased sensitivity to physical and chemical changes at higher brightnesses.

However, there are tentative indications of increased stability shown by the higher temperature samples of the temperature series. Possibly the higher temperatures exert a purifying action upon the pulp and remove some of the reaction products that contribute excessively to color reversion. A more detailed and complete study of this phenomenon appears warranted.

CONCLUSIONS

The following conclusions regarding the chlorine dioxide bleaching of five-stage semibleached southern softwood kraft may be drawn from this work.

1. Strength is little affected by chlorine dioxide bleaching except at excessive temperatures or under alkaline conditions.
2. Addition of sodium hydroxide and consequent higher pH during bleaching reduce the brightness of chlorine dioxide bleached pulp.
3. Increased temperature of bleaching enhances brightness, but at about 180°F. a leveling is noted. At higher temperature, strength is somewhat affected, but brightness reversion is inhibited, possibly due to a purification action.
4. Increased time of bleaching increases brightness but at a greatly reduced rate after 2 hr. (under these conditions, at least).
5. Bleaching pressure up to 30 p.s.i. has little effect upon either strength or brightness.
6. Increasing consistency up to 14% causes slightly increased brightness. Strength is not affected.
7. Under the conditions of these experiments the original brightness of the stock between 66 and 77 had little effect on final brightness.

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Coated Paper Properties and Their Relation to Printability and Print Quality in Lithography

ROBERT F. REED

Printability is defined to mean the combined properties and condition of paper that affect its press performance. The properties involved are plasticity, curling tendency, pick strength, moisture resistance, moisture absorbency, surface ink absorbency, alkalinity, and tinting tendency. The conditions that affect press performance are flatness and freedom from dust, fibers, and foreign matter. Print quality is defined as the general appeal or attractiveness of the printed reproduction to the viewer. This attractiveness is largely subjective and involves realism in tone and color, contrast, smoothness or graininess of tones and solids, sharpness, and clarity of detail. These effects are to a certain extent interrelated and interdependent. In the absence of printability defects and foreign matter, the properties of coated papers that affect print quality are brightness, opacity or "show-through," smoothness, and refractiveness of the coating pigment. The newer ungrained zinc, aluminum, and bimetal plates have made possible improvements in print quality with less ink and moisture than is required by grained plates. But they have also increased certain paper requirements, namely, pick strength and moisture resistance. The increasing use of web offset presses printing at high speeds with smaller cylinders has increased the requirement for pick strength.

For the purpose of this discussion we will consider separately the requirements of coated paper for efficient press production, and those properties that determine the quality of the printed reproduction. We bear in mind, of course, that no single paper can be optimum in all respects, but must represent certain limitations and compromises. These can involve the raw materials, the papermaking process, printing requirements, requirements for end use, and economics.

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Often one or more properties have to be sacrificed in order to obtain other properties. And when the customer selects the paper, his preference may be based largely on aesthetic values or price rather than on processing requirements.

If paper is to be printed by offset lithography, however, there are certain minimum requirements that must be met. Regardless of price or aesthetic values, the paper is satisfactory only if the printing process can be performed efficiently, and if the quality of the printed work is acceptable to the customer. We will therefore discuss coated paper properties under the headings printability and print quality.

PRINTABILITY

By printability we mean the combination of properties and condition of paper that affects its press performance. And by press performance we mean in general:

1. Ability of paper to be fed to the printing unit and delivered in a flat condition.
2. Ability to maintain its dimensions within such limits as will permit good color register.
3. Adequate pick resistance.
4. Ability to receive an acceptable ink impression.
5. Freedom from anything that can adversely affect the printing elements, namely, the offset blanket and plate.
6. Freedom from anything that can interfere with proper functioning of the ink.

The papermaker can't be held entirely responsible for the printability of his paper. The moment it is received in good condition, the lithographer must assume some of the responsibility. If he allows the paper to become wavy or tight-edged, if he fails to adjust his ink properly to the paper or to add sufficient drier to the ink, or if he runs excessive moisture on his plates so that the ink fails to trap or dry, or the paper curls, the fault is his own, not that of the papermaker. Unfortunately, many printing troubles are hard to analyze and even experts disagree as to their causes. All that the papermaker can do is make paper that will meet the known requirements of offset printing, and, through study of recurring troubles, try to improve specific properties without sacrificing others.

The printability requirements for offset papers for sheet-fed and web press work are basically the same with only slight differences. They are essentially as follows:

Flatness

To pass through the uniform squeeze of the offset press impression, sheets must be flat. Otherwise they will be distorted and receive a distorted impression that is fatal to good register. They may even crease or wrinkle. Paper that isn't close to moisture balance with the pressroom atmosphere won't stay flat very long after its moisture-proof wrapping has been removed. This problem has been discussed from the lithographer's standpoint by Hammer and Greenwood of the Forbes Lithograph Manufacturing Co. (*1*).

The problem of maintaining flatness can never be adequately solved until all lithographic pressrooms are air conditioned. In the meantime, the best the papermaker can do is to maintain maximum dimensional stability consistent with other requirements, and supply paper adequately wrapped, with a moisture content that will minimize dimensional changes when it is exposed to the pressroom atmosphere.

Flatness is equally important in web press printing. The rolls should be tightly wound and round, and of uniform diameter from edge to edge. They should be free from corrugations, flats, and soft spots. Lack of flatness can cause misregister, wrinkles, and web breaks.

Mechanical Stretch

Sheet paper is customarily cut grain long and goes through the press in the direction across the grain. The rolling squeeze impression has the effect of elongating the sheets in the cross-grain direction. And since paper has both elastic and plastic properties, some of the elongation may be permanent. When paper is multiple sheeted, the sheets from different rolls may elongate differently causing what is called "sheet-to-sheet misregister." While this may result from excessive impression pressure, the papermaker can minimize it by building a certain amount of rigidity into the sheet and maintaining uniformity in this respect.

Web paper, of course, is run through the press in the grain direction, and elongation due to the squeeze impression is negligible. But rigidity in the sheet tends to prevent misregister and wrinkling if the paper isn't perfectly flat.

Curling Tendency

In all machine-dried and calendered papers the fibers are under stress. If a sheet is dampened and allowed to dry, the fibers relax and the sheet shrinks measurably in both directions. In offset printing the moisture absorbed on the printed side of the sheet can be sufficient to relax the surface fibers. This causes shrinkage of the printed side only and often results in a permanent curl. This is true of coated as well as uncoated papers. Actually it is seldom troublesome except with lightweight papers for calendar pads, and coated-1-side label and box-wrap papers. While the amount of moisture run on the printing plate is an important factor in producing this curl, there is a great difference in papers with regard to their susceptibility to this type of moisture curl. Causes of this difference need investigation.

Pick Strength

Offset printing puts more stress on the paper surface than letterpress printing. The main reasons for this are (1) offset inks are tackier; (2) the film of ink applied to the paper is thinner; and (3) the resilient offset blanket conforms to irregularities of the paper surface more intimately than does a rigid printing surface. So, in general, offset papers must have a somewhat higher pick resistance than papers for letterpress printing.

The pick strength of an offset paper necessary to produce a satisfactory printing job can vary with a number of factors. Halftones and text matter can be printed on a much weaker paper than can solids. When high quality isn't a factor, "soupy" inks can be used to avoid picking of weaker papers. The press size and speed are additional factors. In general, the higher the linear speed of printing and the smaller the diameter of the printing cylinders, the higher the paper's pick strength must be. But, since the papermaker can't always foresee how the paper is to be printed, he generally tries to make it to meet all ordinary requirements.

Recent developments in bimetal and grainless plates that print with less ink and moisture than conventional grained plates, have raised the pick-strength requirement for coated papers somewhat. Also, the increasingly higher speeds of web presses put greater demands on the paper's pick resistance.

Unfortunately the status of pick-strength measurement is unsatisfactory at the present time. Preliminary studies of the various instruments have been made but much more remains to be done. An instrument, no matter how precise or how reproducible its results, can be of little value unless it can rate any series of papers in the same order of pick strength as would a press. After all, the press is the final authority.

Moisture Resistance

The four printability requirements discussed so far apply alike to uncoated and coated papers. Now let's consider those that apply specifically to coated offset papers.

Coated letterpress papers have been printed on the offset press but not very successfully and not for long runs. The reason is that their coating pigment gradually transfers and builds up on the nonprinting areas of the offset blanket so that wash-ups are required every few hundred or thousand impressions. We call this trouble piling. So, for efficient printing, offset coatings must have some degree of mositure resistance. The coating size or adhesive doesn't have to be completely insoluble. But just how insoluble it has to be is hard to determine. Wet-rub tests are helpful for comparison of different papers but can't predict accurately what marginal coatings will do on the press. All the paper coater can do is to allow a factor of safety.

Another aspect of this problem is seen when the coating piles on the printing areas of the blanket instead of on the nonprinting areas. This usually happens on the second, third, or fourth unit of a multicolor press. After a few hundred or thousand impressions, the medium halftone areas develop a peculiar mottle, and the piling can be seen and felt on the blanket. In most cases we have seen, the paper showed a high degree of wet-rub resistance and produced no piling whatever on the nonprinting areas. But the piled material, when scraped off the printing areas, was shown to be a mixture of coating pigment and ink. So far, the best explanation for this type of piling is that the press moisture in the first printing softens and "tackifies" the coating adhesive so that traces of the coating are lifted off by the tacky ink in printing the succeeding colors. Repetition causes the coating thus transferred to build up as a puttylike cake on the blanket surface. The reason why this occurs principally in medium halftones can only be that these areas provide a critical combination of ink, moisture, and picking force.

Comparative tests have shown that coatings which caused piling on the printing areas of the blanket developed more tack in contact with the moist finger than coatings which did not. Also they were more easily ruptured by the "wet-thumb" test. These tests indicate that, when the coating adhesive is moistened, it doesn't dissolve but becomes a weak gel.

Piling, on both the nonprinting and printing areas of the blanket, seems to be aggravated when the printing is done from bimetal plates. This may seem strange, since these plates usually require less moisture than conventional grained plates. But actual press tests have shown that the tendency of a coating to pile varies inversely with the amount of moisture run on the plate.

Moisture Absorbency

If, while printing, you stop a press and quickly examine the inked image areas on the plate with a strong glass or microscope, you will see myriads of tiny water droplets on the surface of the ink. They are roughly 0.001 in. in diameter. They represent about the same amount of moisture per square inch as that on the nonimage areas. Similar water droplets are also present on the inked areas of the blanket before they contact the paper. And unless the paper surface is absorbent enough to imbibe these minute water droplets almost instantaneously, they act as a barrier and prevent the ink from being transferred to the paper as a uniform film. When this happens, printed solids are "snowflaky" and weak, and halftones have a grainy, washed-out appearance.

Lack of moisture absorbency can also cause trouble in printing on multicolor presses. The minute film of moisture transferred from the blanket to the unprinted areas of the paper by one printing unit, may still lie on the paper surface and prevent it from accepting ink properly from the succeeding unit.

Both of these troubles are minimized in printing from bimetal plates since the moisture they require is less than for grained plates.

The mositure absorbency of paper coatings is therefore an important factor in their printability, but it is not easy to measure. Differences between papers can be demonstrated roughly by comparative tests. If, as seems logical, moisture absorbency depends on wettability and capillarity of the coating, contact angle measurements should be of help. And the avoidance of hydrophobic materials in offset coatings would be indicated.

Surface Ink Absorbency

Surface ink absorbency of a coated stock affects printability only if the ink can't be properly adjusted to it. It can vary rather widely depending on whether the sheet is to be printed with conventional or gloss inks, and whether the printed job is to be press or spirit varnished. The important thing is that ink absorbency be the same from sheet to sheet, and that it be uniform over the individual sheet surface. If it varies from sheet to sheet, there may be trouble keeping the ink properly adjusted to prevent offset or chalking. If it varies on the individual sheet, the printed ink film will have a nonuniform mottled appearance.

Dust

The dust problem is too well known to need comment. The presence of slitter or cutter dust makes it impossible to produce acceptable printing.

Coating Alkalinity

While a few modern coated stocks show a coating pH of 6.5 to 7.0, most are in the range 7.5 to 9.0. Coating pH influences the drying of inks, and, as a general rule, the higher the pH value, the faster inks will dry. The

difference may be hardly detectable at low relative humidities, but can be very great at high humidities. However, pH isn't the only factor. Papers from different mills show rather marked differences in ink-drying rate, even though their coating pH's are about the same. In some cases, but not all, this can be explained by differences in ink absorbency.

Tinting Tendency

Occasionally we find a lot of coated paper on which an all-over tint develops during printing. When a lift of another paper is inserted in the feeder pile, this tint quickly clears up, but comes back almost immediately with the original paper. The tint is due to emulsification of ink in the dampening moisture, and this can only be caused by some surface-active material in the paper coating. Inks can be a contributing factor since some break down more easily than others.

So far the best indication of tinting tendency is the stability of the foam produced when a water extract of the coating is shaken violently in a test tube, but it is not 100%. It usually identifies papers that have given tinting trouble on the press, but doesn't always predict that a paper will cause trouble. If all inks resisted emulsification equally, this test would probably be more dependable. However, you can be quite sure that a coating will not cause tinting if its extract will not support a foam for longer than about 30 sec. Surface tension measurements on coating extracts seem to be less reliable than the foam test in indicating tinting tendency.

PRINT QUALITY

There is no clean-cut separation of the factors that affect printability and those that affect print quality. Naturally such things as misregister, picking, piling, failure of ink to trap, offsetting, chalking, and tinting, can detract from print quality. But, since the pressman has to match his O.K. sheet, he must either adjust the press and ink conditions to keep these factors under control, or reject the paper if everything else fails.

In recent years there have been important developments in lithographic printing plates that have enhanced their printing quality and have generally raised the goals and standards for quality in printing reproduction. These plate developments are:

1. Improvements in the desensitization of nonprinting areas and the resultant trend toward finer plate grains.
2. Improvements in the ink receptivity of printing areas through the use of better lacquers.
3. The development of ungrained bimetal plates.
4. The development of ungrained zinc and aluminum plates.

As a result, there have been considerable improvements in image definition resulting in lengthening of the tone scale in halftone reproduction. But these improvements can't be taken full advantage of without paper that can contribute its share to quality reproduction.

The factors classified in this discussion as affecting print quality are arbitrarily limited to the paper qualities that determine the general appeal or attractiveness of the printed reproduction to the viewer. This attractiveness is largely subjective and involves realism in tone and color, contrast, smoothness of tones and solids, sharpness, and clarity of detail. These effects are to a certain extent interrelated and interdependent. While they are subjective, some of the physical and optical properties of the coated surface that produce them are measurable and others are being studied.

Brightness

Brightness of the coating contributes to contrast in the printed subject, and therefore to brilliance, snap, and sparkle. Brightness should also be uniform. Coatings that show a blackened fiber pattern detract from print quality, most noticeably in large areas of halftone tints.

Opacity

Opacity determines the amount of show-through of matter printed on the reverse side of the paper. Noticeable show-through always reduces contrast and detracts from print quality.

Smoothness

The smoother the coating surface, the thinner the ink film that is required to cover it, and the better the rendition of tones and the sharpness and clarity of detail. But coatings that are not absorbent require special inks and techniques in printing to secure adhesion and prevent offsetting. Some degree of ink and moisture absorbency is necessary to proper ink receptivity under modern high speed printing conditions.

Refractiveness of Coating Pigment

The work of Yule, Nielsen, and Clapper of the Eastman Kodak Co. (*2, 3*), has shown that light reflected from paper is the result of both surface and internal reflections. Light falling on printed halftones is partly absorbed due to internal scattering, so that the white areas between the dots appear to be lower in brightness than large white areas under the same illumination. The greater the amount of internal scattering, therefore, the lower will be the contrast. And low contrast means lack of brilliance, snap, sparkle, and clarity of detail. This is without doubt an important reason why coated papers give higher print quality than uncoated papers. Coating pigments are more opaque than fibers, and since they are concentrated at the paper's surface, less light can penetrate deeply into the body of the paper and be lost through scattering.

Even with coated papers the amount of light scattering depends on the depth to which light penetrates the coating. When the coating contains a maximum of titanium dioxide, the depth of light penetration is a minimum and the contrast in the halftones is a maximum. This contrast is therefore related to the specific opacity of the coating itself and not to the over-all opacity of the coating or of the paper. A clay coated sheet with the same measured opacity and brightness as a titanium dioxide coated sheet would show a considerably lower contrast and general print quality.

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Design Features Affecting Digester Corrosion

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This paper is a presentation of the facts brought forth during the roundtable discussion of the TAPPI Corrosion Committee held at the 40th Annual Meeting of TAPPI in New York, N. Y., Feb. 20, 1955. The discussion was divided into six subjects all pertaining to digester design and its effect on corrosion in alkaline pulping. The subjects were: (1) digester circulation systems; (2) supports for digesters, pedestal versus skirt type; (3) design of internal projections and means of baffling to protect the digester walls from streak corrosion attack; (4) surface preparation of carbon steel and alloy lined digesters; (5) stress relief and radiography of sulphate digesters; and (6) field repair of digesters. A factual analysis of the first five* discussion subjects finds that preferential corrosion attack takes place in specific areas of digesters because of nonuniform circulation within a digester. The chief factors affecting circulation in this type of system are uniformity of chip size, chip loading, chip packers, liquor volume, steam inlets, and digester relief. Skirt-type supports eliminate the localized corrosion fatigue found to be caused by pedestal-type supports. Proper design of internal projections keeps streak corrosion at a minimum. Mill scale should be removed entirely before putting a carbon steel digester into service. It is the common practice to retain the standard mill finish on alloy liner plates. Stress relief of welds should be employed whenever practical to keep stress corrosion cracking at a minimum.

This is the first of two technical reports produced by the TAPPI Corrosion Committee as a result of a cooperative committee roundtable discussion on digester design to reduce corrosion. The meeting was held during the annual TAPPI Convention last February, 1955, in New York City.

The original idea concerning the influence of design on corrosion in digesters was conceived in committee activity and became the basis for a roundtable discussion through the suggestion and help of M. A. Scheil, A. O. Smith Corp., Milwaukee, Wis.

Each subject of the discussions was assigned beforehand to various members of the TAPPI Corrosion Committee. The basis of individual assignment was on past experience with a particular phase of the problem. Acknowledgment is hereby given to the members for their cooperation and factual information produced at the meeting. Those participating are listed at the end of the report.

The complete stenographed report of the roundtable comprises some 168 pages of discussion. The following is a condensed report of that discussion.

Potentially this type of meeting and discussion may be a practical aspect leading toward the solution of the existing corrosion problems in digesters and surely is an aid to the cross exchange of actual experiences in various pulp and paper mills.

DIGESTER CIRCULATION SYSTEMS

There are two prime classes of circulation systems employed in kraft mills today. These are the direct steam or natural circulation system and the mechanical circulation system.

In the direct system, as the name implies, the steam is normally introduced directly into the bottom of the digester, and circulation is accomplished mainly by convection. The chief factors affecting circulation in this type of system are: (1) uniformity of chip size, (2) chip loading, (3) chip packers, (4) liquor volume, (5) steam inlets, and (6) digester relief.

Size and uniformity of size of chips, as mills have discovered, affect not only pulp quality, but also circulation. Uniformity of chip size is a prime factor in the corrosion problem. Nonuniformity causes channeling of the liquor and subsequent preferential corrosion.

It has definitely been established that preferential corrosion exists when chips pile up unevenly. This attack takes place primarily on the surface above the low side of the chip mass and is shown in Fig. 1. This preferential corrosion is due mainly to more rapid liquor movement on the low side because of less dense chip packing. To a lesser extent the attack may be attributed to the incoming liquor being deflected off the unevenly piled chips onto the hot walls of the digester and rapidly evaporating. This phenomenon is commonly termed "hot plate boiling."

Chip packers are of service in loading the digester uniformly. Many mills run the liquor and chips in together which allows the liquor to act as a packer. Care must be used in this type of arrangement to prevent "hot plate boiling." Overpacking must also be guarded against or circulation will be impaired.

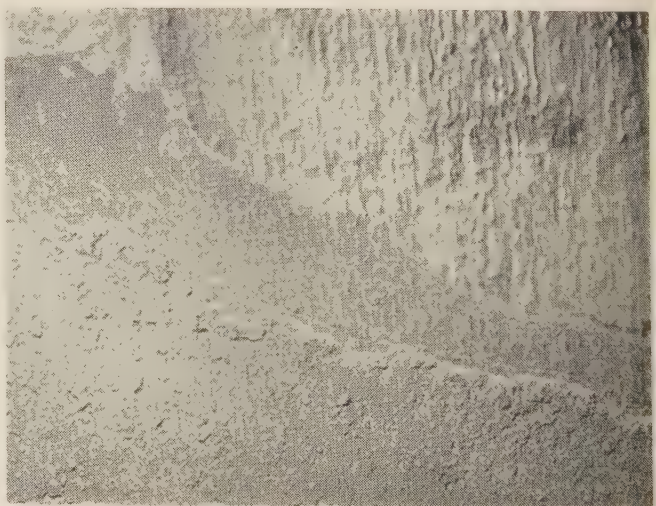

Fig. 1. Closeup of carbon steel in the top shell of an alkaline digester where the steel was affected by liquor spray. Magnification 1×

* Subject 6 will be prepared as a separate paper to be presented at a later meeting.

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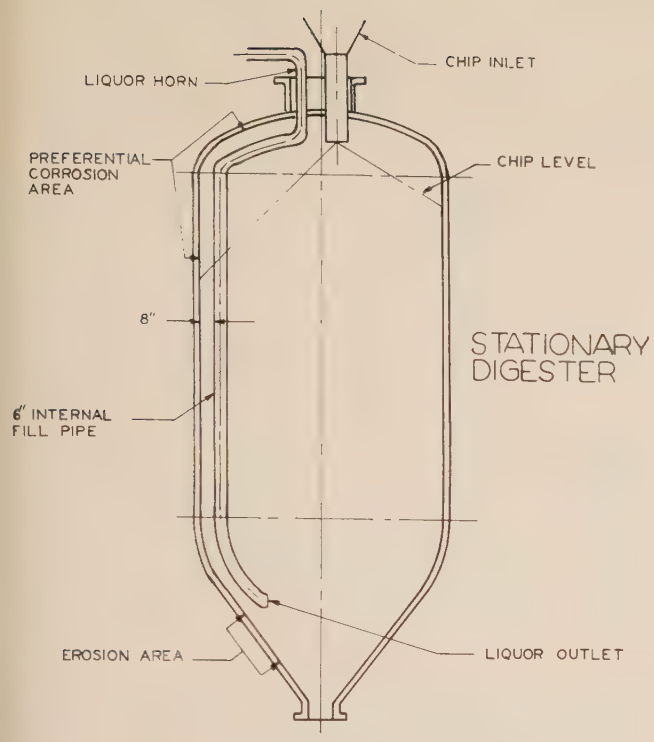

Fig. 2. An internal liquor charging method for stationary digesters

Liquor volume is also of importance. Too much liquor volume results in excessive pull-over through the relief giving difficulty in starting circulation. Too little volume often results in scorched chips, and circulation tends to be erratic.

There are several systems of chip loading and liquor introductions used to try to eliminate these problems with varying degrees of success. Work has been done with loading the chips into the center of the manway and introducing the liquor either directly into the chip stream or at different locations in the digester. One method of liquor introduction shown in Fig. 2 illustrates an internal fill pipe running parallel to the vessel interior 8 in. from the wall. This pipe has a kickup at the bottom. There is a tight-fitting internal joint between the pipe and the liquor charging horn which swings down during filling. This system has worked satisfactorily to date, but presents the problem of having an eroded/corroded area under the liquor outlet in the bottom cone caused by liquor spilling out during filling. The erosion/corrosion is caused mainly by "hot plate boiling."

Figure 3 shows a modification of this system which uses an extension of the liquor inlet pipe to the bottom of a tumbling digester. Erosion/corrosion below the end of the inlet pipe is also a problem of this system. This difficulty could be eliminated if the chip mass is allowed to reach the level of the fill pipe before the liquor flow is started. Both of these systems present the additional problem of losing approximately 8% of the obtainable chip volume in the digester during the "cook" due to floating.

Many companies which had been using short stub liquor inlets were experiencing preferential corrosion. Upon changing over to the above type of liquor inlets, previously corroded areas scaled up and corrosion became more uniform around the circumference of the vessel. This indicates that this is an effective solution to the problem.

Another solution suggested is to add the liquor to the digester after the filling of the chips is completed. There is much less corrosion with this arrangement but the filling time is longer and the volume of chips is less.

An alternate method of liquor introduction employs the liquor inlet in the center of the chip stream. The liquor is then surrounded by a protective shield of chips at all times. In this type of setup the chip flow must be equal on all sides of the liquor inlet or the condition of unequal chip piling results. This method is not as good as adding the liquor after completion of chip charging because the chips on the low side are more saturated with liquor and, therefore, corrosion is accelerated.

A false bottom, perforated in the central portion, for introducing the liquor has been used successfully by some mills. In this type of arrangement the liquor does not come in contact with the chips during filling until it comes up through the holes. Introducing the liquor in the center of the digester reduces the problem of preferential corrosion to a great extent.

Figure 4 illustrates a liquor introduction system used in a Wisconsin pulp mill. This pulp mill uses tumbling-type digesters. When the digester is being filled the black liquor flows through a conventional liquor horn, and the white liquor is introduced through a perforated distributor ring in the upper portion of the vessel. This distributor ring is then used as a steam inlet for cooking after the filling is completed and the vessel is inverted.

Steam inlets have a great effect on circulation. If steam emission is not fairly uniform over the bottom of the digester, poor circulation results with accompanying poor quality pulp and preferential corrosion attack. Steam inlets are many and varied, the most common type being multiple nozzles evenly spaced around the bottom of the digester. If these nozzles are fed from a common header pipe, the flow of steam is uneven from

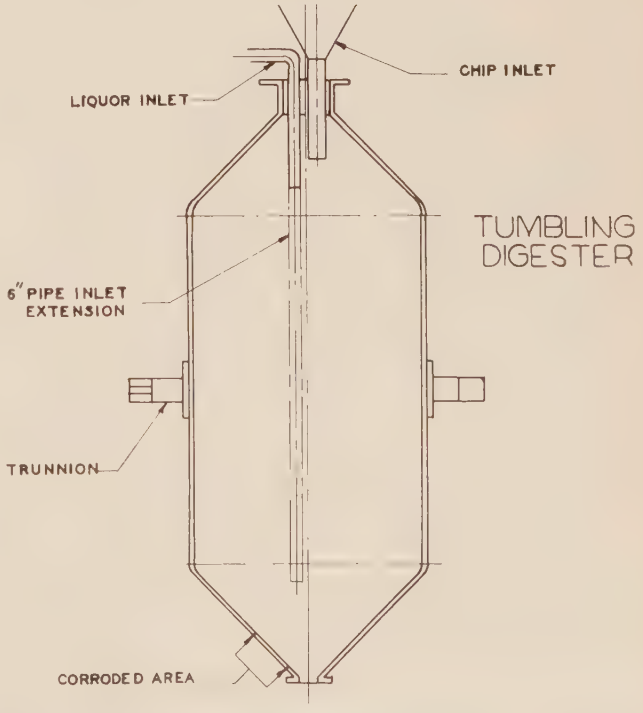

Fig. 3. An internal liquor charging method for tumbling digesters

the nozzle. Perforated steam taps are often used to obtain greater diffusion within the digester. Other type steam inlets in common use are internal steam rings and perforated steam pipes located near the bottom of the digester. Figures 4 and 5 show two types of steam distributor rings used in tumbling digesters. Figure 5 is a conventional setup. The arrangement shown in Fig. 4 is one previously mentioned. These systems have one disadvantage in that pulp accumulates above the distributor ring and drips liquor causing streak corrosion. This problem is discussed later under Design of Internal Projections.

Steam is also introduced by means of a series of steam nozzles spaced around the bottom of the cone as shown in Fig. 6. These nozzles are protected by perforated caps welded over them. These caps are prone to excessive wear and must be replaced frequently. Replacing the cap necessitates cutting off the old cap and welding a new one in place. Figure 7 shows an alternative solution to this costly replacement problem. In this system the steam nozzle is cut off flush with the inside of the vessel wall and a perforated pipe is inserted in the nozzle extending into the vessel. If this perforated pipe is made of Inconel, stainless steel, or some other corrosion-resisting material, the corrosion problem is lessened. Replacement also is much easier as the pipe may be removed through the nozzle outside of the digester. A third alternative, also shown in Fig. 7, is to use both the perforated steam nozzles plus a steam nozzle in a spool fastened to the bottom blow nozzle. The reason the spool is added rather than placing the steam nozzle directly in the blow nozzle is to prevent scoring of the blow valve by the steam. This occurs if the nozzle is too close to the valve.

Adequate digester relief is a must requirement for good circulation. If air and other noncondensable

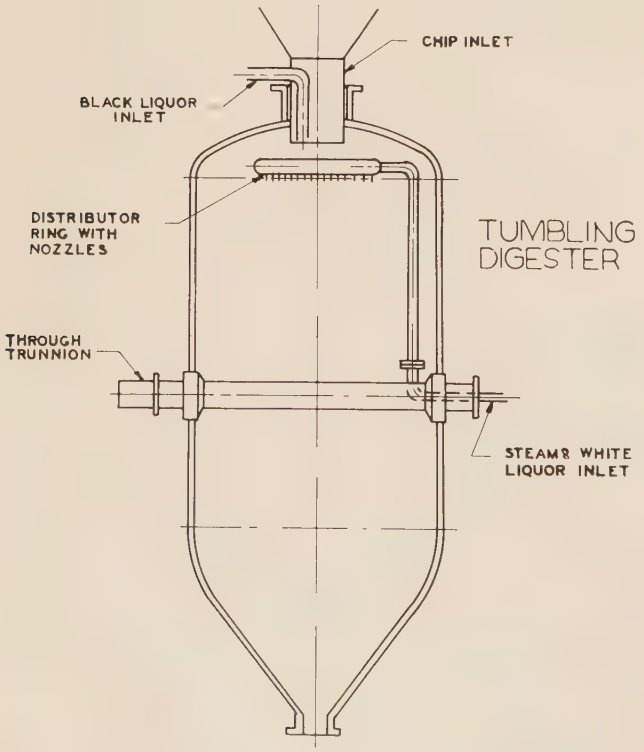

Fig. 4. Distributor ring setup used in some tumbling digesters

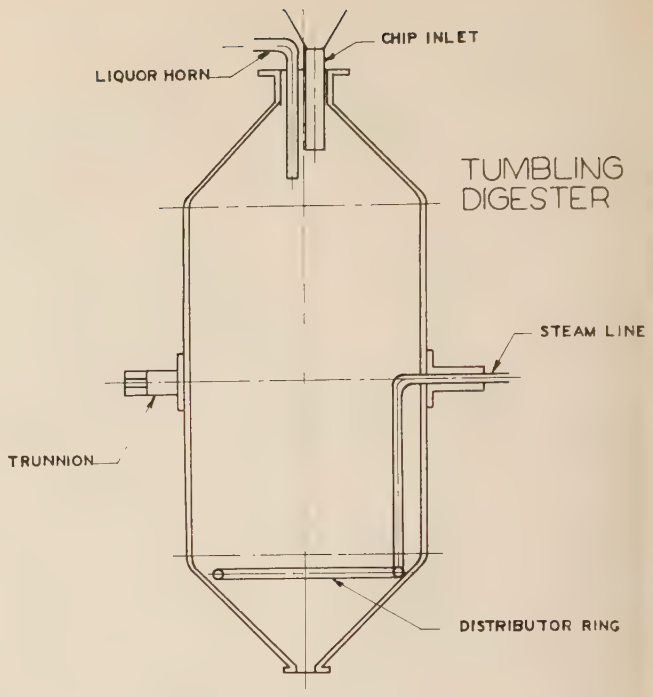

Fig. 5. Conventional distributor ring setup used in tumbling digesters

gases are not removed from the digester as needed, circulation by convection is nearly impossible.

Mechanical circulation systems are the other main class of circulation systems. In this type of system hot liquor is pumped into the digester under pressure. The trend of circulation systems now is to introduce the major portion of the circulating liquor into the top of the vessel and the remainder into the bottom of the digester. It is allowed to circulate and normally is removed through a stainless steel strainer located in the center of the digester. The liquor is then piped through a heater and recirculated. A typical mechanical circulation system, used in a kraft digester, is shown in Fig. 7A. The prime area of corrosion attack is where the strainer is welded to the shell. A commonly used solution to this problem is the welding of a carbon steel plate between the strainer and shell, but this does not entirely eliminate the problem.

The other main corrosion problem in a mechanical circulating digester is corrosion of the outlet nozzles. The corrosion is a function of liquor velocity rather than total circulation rate. This problem can be lessened by using multiple nozzles. This is the current practice in many mills. By increasing the number of nozzles with the total circulating rate remaining constant, the liquor velocity through the nozzle decreases. Aside from the problem of corrosion in the nozzle, circulation rate seems to have little effect on corrosion.

SUPPORTS FOR DIGESTERS—PEDESTAL VERSUS SKIRT TYPE

The improper design of digester support may be responsible for accelerated corrosion in many digesters in operation today. The corrosion causes localized loss of metal or cracking due to fatigue.

The pedestal type of support has the disadvantage of concentrating loads (the weight of the digester and its contents) over a small area, particularly if the pedestal ribs are attached directly to the cone plates. Weld-

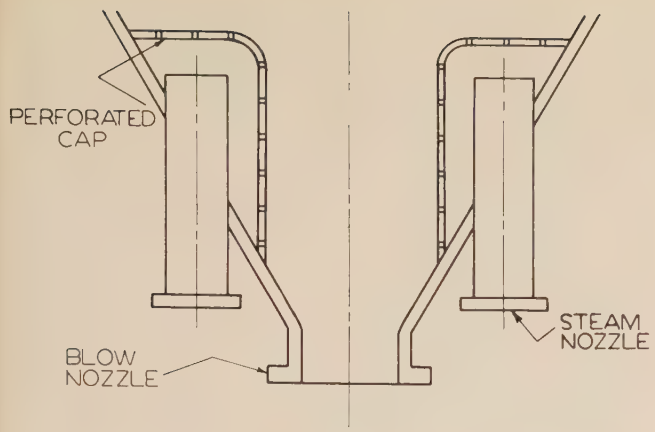

Fig. 6. Schematic diagram of capped steam nozzles

ing of the supports can cause distortion due to shrinkage and these stresses cause the metal to become more susceptible to corrosion. Heat is retained at the location of the supports. This is another disadvantage as the retained heat causes hot plate boiling resulting in localized corrosion. Figure 8 illustrates how localized corrosion is related to this type of support.

Corrosion fatigue is a further cause of failure associated with this support. Mechanical steaming, using cams cut on a gradual rise, has not resulted in the gradual opening of the steam valve. Instead, the steam valve is blown wide open at the start of the cook and the digester vibrates violently setting up indeterminate stresses at the pedestal supports. After about 15 min. the valve closes down and the cam contour is followed.

An example of failure of a carbon steel digester in Australia reported in *APPITA Proceedings* 4: 18 (1950) illustrates how a combination of causes can end disastrously. Because of excessive corrosion, the cone of the digester was lined with preformed $^3/_8$-in. thick carbon steel strips and attached by plug welding. After $2^1/_2$ years of operation, the vessel failed, leaking steam from a crack in the bottom cone near a pedestal support. This crack was 16-in. long on the outer surface of the digester and extended for 92 in. inside. Further examination revealed that cracks of varying length existed in areas around the three remaining pedestals. Subsequent metallurgical investigation placed the cause of failure on corrosion fatigue following the strip lining operation. High residual welding stresses were present in the cone plates since the digester had not been stress relieved following strip lining. Fluctuating stresses due

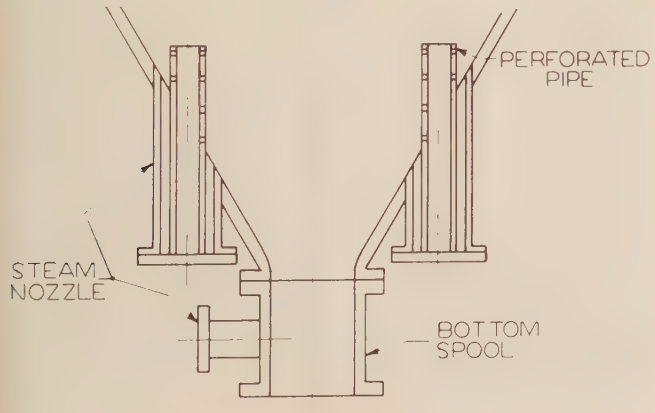

Fig. 7. Schematic diagram of removable perforated pipe steam nozzles

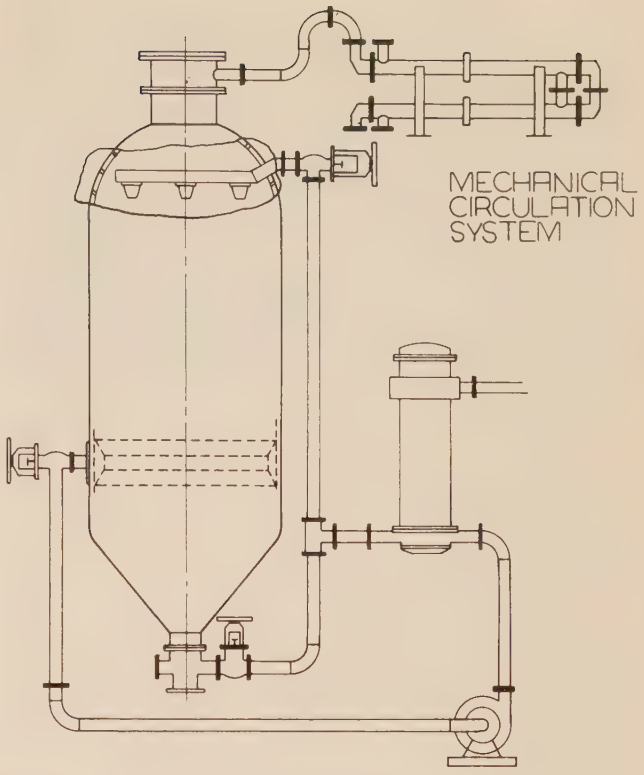

Fig. 7A. Typical mechanical circulation system used in a kraft digester

to the digester load and the steam pressure caused the plug welds to shear or crack. This permitted the cooking liquor to concentrate behind the lining, and, in combination with the high stresses, caused transgranular cracking in the grain-coarsened, heat-affected zone of the weld. These created a notch effect giving rise to the development of corrosion fatigue cracks which followed the general direction of the largest grain size and maximum stress. Figure 9 shows the location of the cracks in the cone with respect to these pedestal supports.

The solution to this problem of digester support corrosion is the use of a skirt-type ring, shown in Fig. 10, which distributes the load over a greater area and decreases the concentration of stresses. The use of this type of support, with the modification that the digester is not tied down, reduces the stress caused by vibration.

Ninety-five per cent of the digesters being built today are manufactured with the skirt-type ring support because paper mills employing this design have no corrosion problems that can be traced to its use.

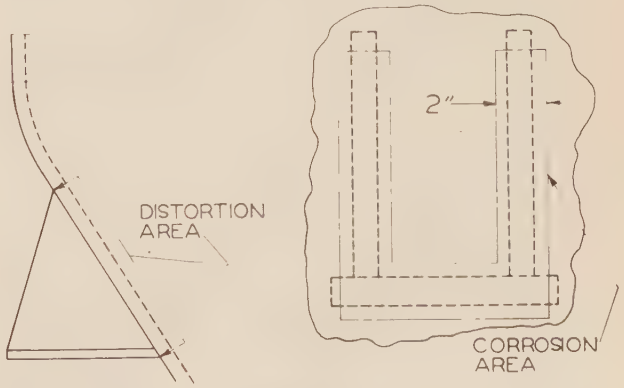

Fig. 8. Relation of localized corrosion to pedestal type supports

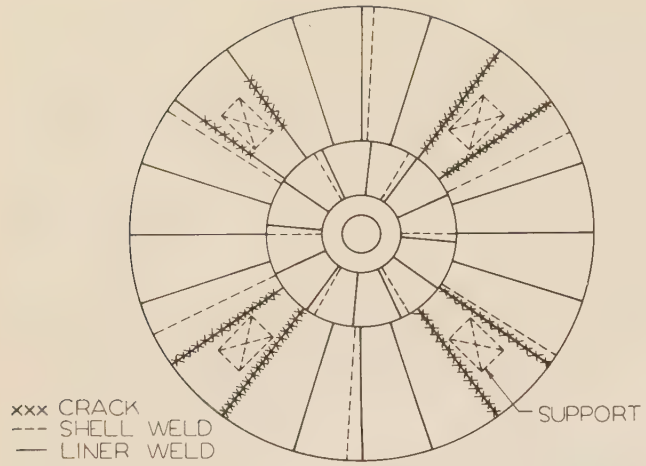

Fig. 9. Diagram showing the failure of the Australian carbon steel digester at the location of the supports

DESIGN OF INTERNAL PROJECTIONS AND MEANS OF BAFFLING TO PROTECT THE DIGESTER WALLS FROM STREAK CORROSION ATTACK

The main cause of streak corrosion is hot plate boiling resulting from the evaporation of cooking liquor on the hot metal surface either during liquor charging or from pulp hang-ups between cooks.

Unused nozzles can cause streak corrosion if not blanked off properly by permitting liquor and liquor-saturated pulp to accumulate. A common practice is to blank off these nozzles by simply bolting a blind flange onto the connection outside of the digester. However, after the digester is blown, this retained liquor runs down on the hot walls of the digester causing hot plate boiling and streak corrosion. To properly blank off an unused nozzle, a chamfered plate is welded over the opening in the interior of the vessel as shown in Fig. 11. Another solution is the use of a metal plug welded flush with the digester wall.

Pressure connections or other nozzles also create conditions for streak corrosion. Liquor accumulates in these nozzles during cooking and drains down the walls of the digester after the blow. To correct this, nozzles should be provided with lip extensions to prevent

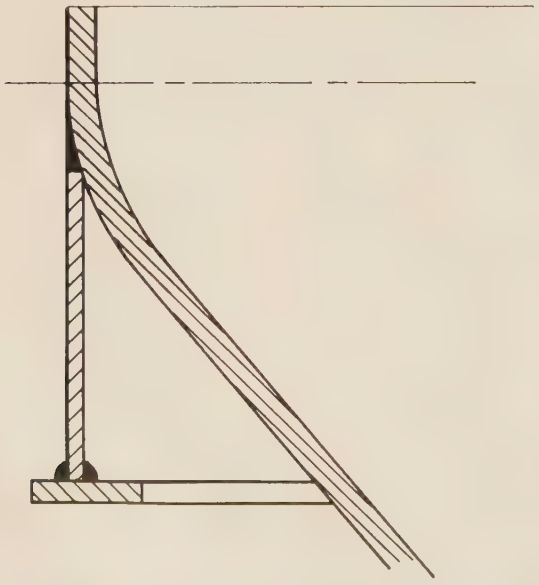

Fig. 10. Typical construction of skirt-type support

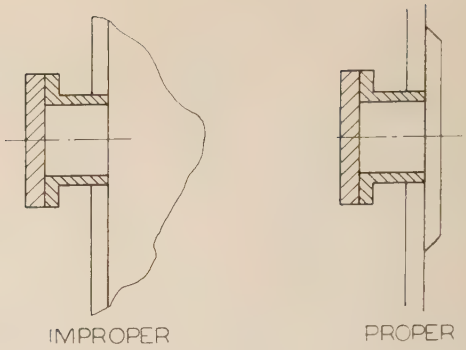

Fig. 11. Methods of blanking unused connections

liquor contact of the digester walls. Figure 12 shows the effect of streak corrosion below a liquor charging nozzle. This nozzle has a lip extension to prevent streak corrosion, but it is of insufficient length to protect the shell.

A $^{3}/_{4}$-in. pressure indicating nozzle, flush with the digester wall, is shown in Fig. 13. This illustrates how streak corrosion causes type 316 stainless steel lining to become thinned. To eliminate this, the nozzle should be extended or provided with a baffle as shown in Fig. 14.

Liquor-saturated pulp accumulates on top of nozzles which protrude into the vessel, causing the absorbed liquor to drip onto the walls between cooks. By canting these nozzles downward at an angle greater than the angle of repose of the stock, accumulation is minimized.

SURFACE PREPARATION OF CARBON STEEL AND ALLOY LINED DIGESTER

Carbon steel plates, as used for digesters, normally are covered with an iron oxide resulting from the hot

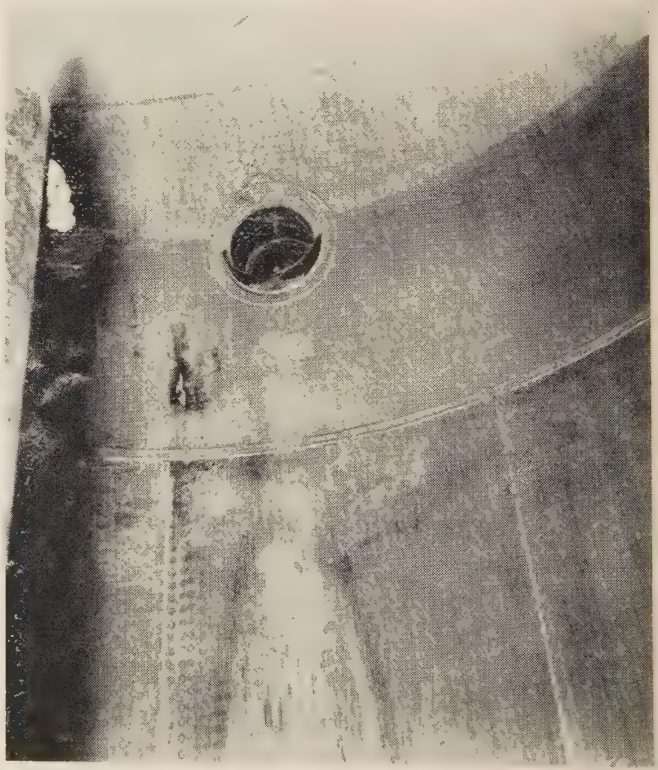

Fig. 12. Streak corrosion below a short nozzle lip extension. Magnification $^{1}/_{10}\times$

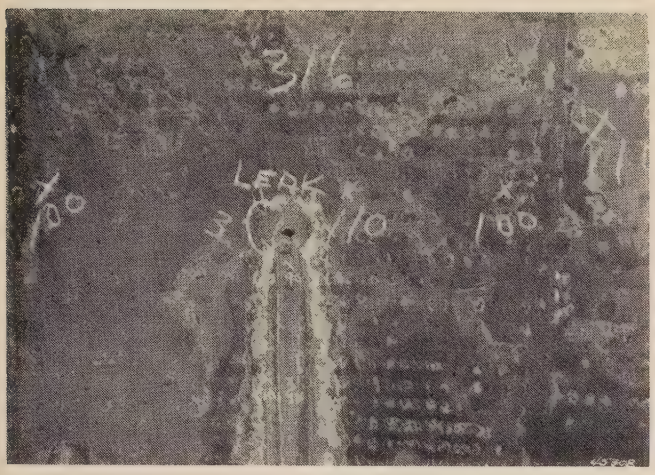

Fig. 13. Streak corrosion below a flush small pressure-indicating nozzle. Magnification 1/4×

rolling operation at the steel mill. During fabrication into digesters, this scale occasionally flakes off leaving a discontinuous mill scale covered surface on the plate. This broken film creates a condition for an accelerated corrosion attack in the unscaled areas due to the electrogalvanic action between the mill scale and the exposed carbon steel. The effect of this action is shown in Figs. 15 and 16 illustrating preferential corrosion of perforated mill scaled areas. For this reason it is preferred to remove the discontinuous mill scale from the inside surface of the digester by sandblasting before it is placed in service.

Digester scale, calcium carbonate, if it can be retained as a continuous film, is beneficial in reducing corrosion of the carbon steel surface. The sandblasting done prior to placing the digester into service roughens the surface and promotes this scale formation. Mills that have sandblasted their digesters are in the process of evaluating the merits of this method of surface preparation.

Alloy linings for alkaline kraft digesters do not seem to be susceptible to pitting corrosion attack beneath carbonate scale. Sandblasting roughens the surface and exposes a greater area to corrosive action but the roughened surface will promote scale formation which will offer some corrosion resistance.

A different problem is presented to digester fabricators when designing alloy lined digesters for use in sulphite pulping. Formation of digester scale can result in pitting corrosion attack. In one instance sand-

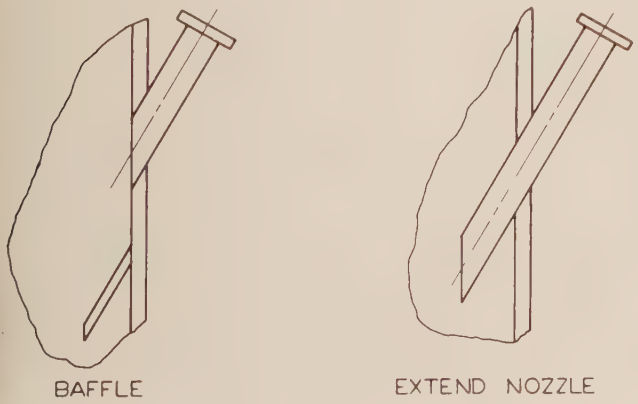

Fig. 14. Methods of preventing streak corrosion

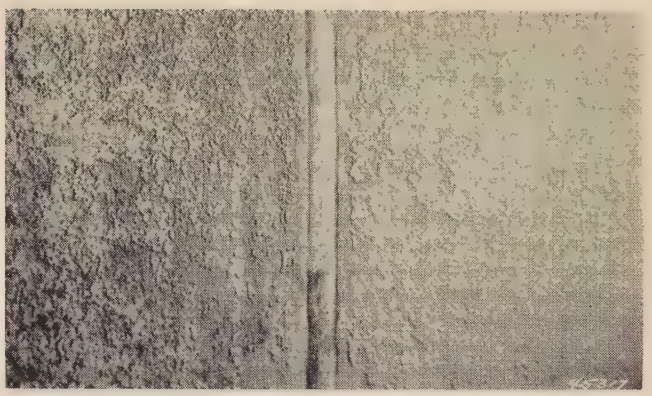

Fig. 15. Pitting corrosion on the longitudinal seam of the shell of carbon steel kraft digester after 9 months of service; i.d. surface not sandblasted before digester went on stream. Magnification 1/3 ×

blasting of the alloy lined surface promoted scale formation as illustrated in Fig. 17. An area protected by masking tape on the type 316 surface of a sulphite digester before sandblasting retained the original 2D mill finish. A tightly adhering calcium sulphate scale formed only on the roughened surface. When this scale is permitted to build up, pitting corrosion and stress-corrosion cracking can result. Figure 18 shows a closeup of pitting corrosion in a type 318 clad sulphite digester due to formation of scale. The photo has been taken after removal of the scale by disk sanding after 7 months' operation but it is noted that the pits still retain the scale. Figure 19 shows the extensive stress-corrosion cracking found at the bottom of the pits shown in Fig. 18.

Build-up of calcium sulphate scale behind the screens in a sandblasted type 316L lined sulphite digester produced pitting and stress-corrosion cracking shown in Fig. 20.

It is well known that the finer the surface finish the less is the possibility of scale formation and the accompanying pitting corrosion in alloy lined sulphite digesters. Grinding of stainless steel has been reported

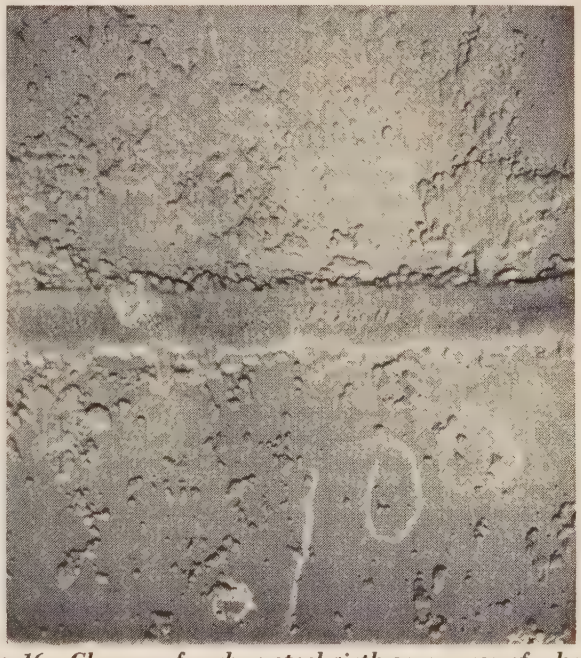

Fig. 16. Closeup of carbon steel girth seam area of a kraft digester following 22 months of service; no sandblasting of surface before digester was put into service. Mag. 3/4×

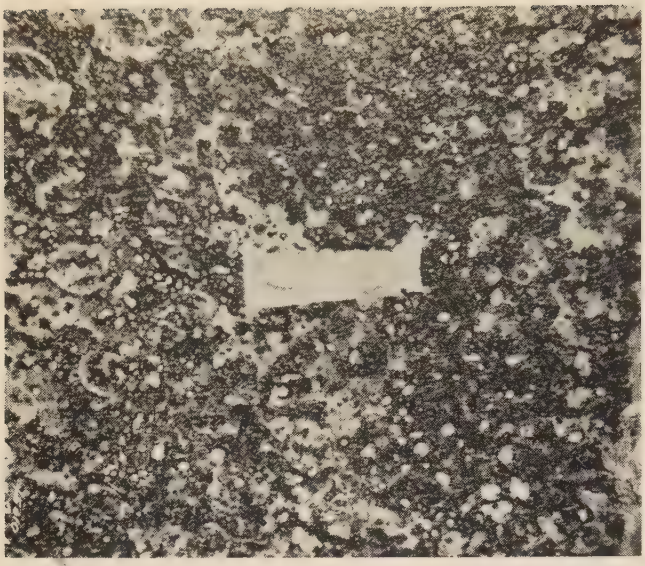

Fig. 17. Calcium sulphate scale deposit on T316L Smithlining; liner protected by masking tape during sandblast, representative of 2D finish, has not retained scale. Mag. 1×

to be responsible for surface stress-corrosion cracking of the alloy. Polishing to create a smooth surface is an expensive alternate and few fabricators will furnish digesters with polished interiors. The most economical and acceptable alternative is using stainless steel with the standard mill finish for sheets.

The corrosion resistance of stainless steels is due to the presence of a very thin, continuous, transparent surface layer or passive film, which forms naturally on clean surfaces when exposed to the atmosphere or to oxidizing conditions, such as passivation with certain acid mixtures containing oxidizing agents. Passivating of digesters has not been used to any great extent in the paper industry and its advantages here are doubtful. If heavy digester scale is removed periodically, pitting corrosion can be effectively combated in stainless steels in sulphite service and the alloy can passivate itself on exposure to the atmosphere between cooks. Figure 21 illustrates how the periodic flushing through a nozzle has prevented the formation of scale and its

Fig. 18. Closeup of pitting corrosion in a type 318 clad sulphite digester due to formation of scale. Photo taken after the scale had been removed by disk sanding. Pits still retain scale

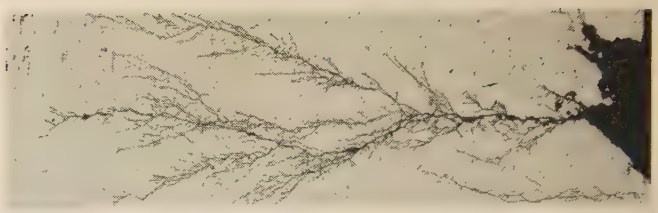

Fig. 19. Extensive stress corrosion cracking of T318 clad due to pitting corrosion in sulphite digester. Mag. 50 ×

attendant pitting corrosion from occurring in the area of the type 318 clad sulphite digester affected by the liquid flow. The pitted surfaces had been exposed when the shell surfaces were disk sanded to remove digester scale.

STRESS RELIEF AND RADIOGRAPHY OF SULPHATE DIGESTERS

Insurance company records indicate that in nearly all carbon steel digesters, corrosion is being experienced at the welded seams and/or adjacent to the seam in the heat-affected zone. The insurance people are strongly in favor of relieving the residual stresses at the welds by some means of stress relieving.

When the edges of plates are brought to the fusion temperature by welding, the heat is dissipated by being conducted away from the weldment by the parent metal and atmosphere. A short distance from the weld the metal temperature remains fairly low so that the parent metal is rigid and acts as a restrainer. The area in the metal being welded becomes plastic and being restrained by the cooler, rigid metal, the weld area is upset and loses some of its strength. While cooling, it regains its strength at about 800°F. and any further decrease in temperature causes shrinkage and a residual stress approaching the yield value. Residual stresses can be kept at a minimum and well within the desired range by preheating and postheating during the welding. Heat dissipation is retarded sufficiently to retain a reasonable ductile property in the welding zone thereby reducing contraction or shrinkage stresses.

Stress relieving cannot be accomplished at the operating temperatures of the digester, around 380°F., as many people believe, since the material is within the normal elastic range of the steel at room temperature. To effectively stress relieve digesters, they should be

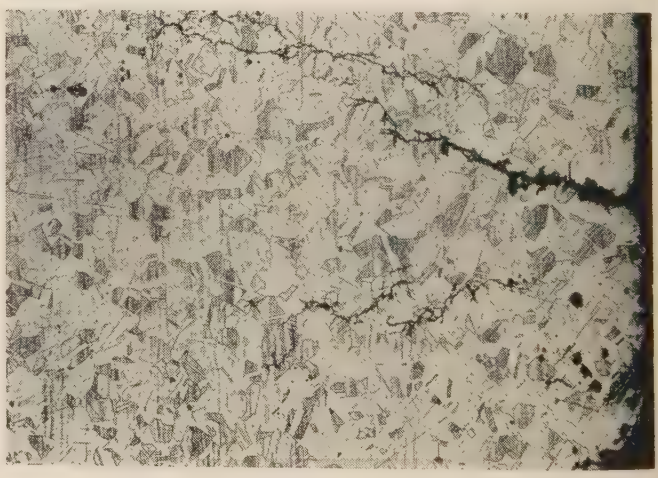

Fig. 20. Etched cross section of crack and pit in T316L lining. Mag. 100×

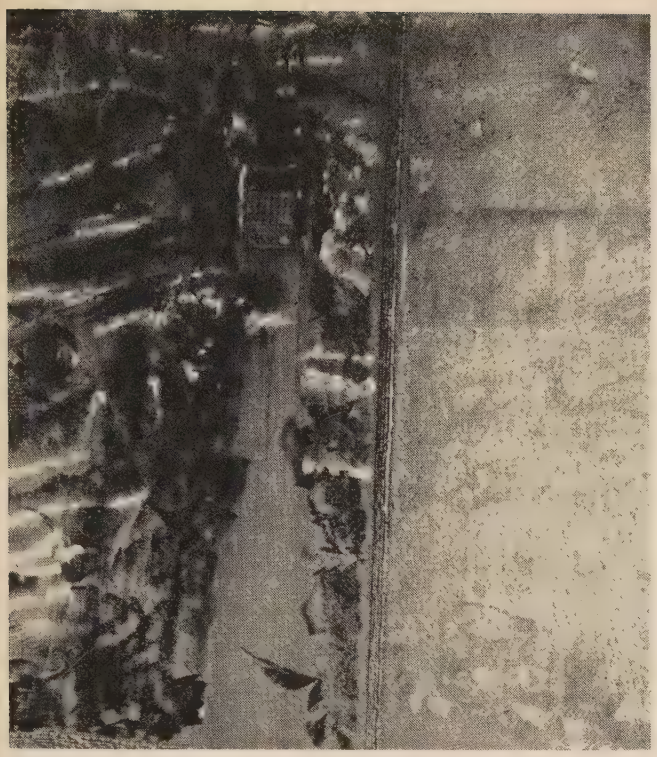

Fig. 21. Level filling recorder in bottom shell of T318 clad. Note how scaling has been eliminated in area below screen due to nozzle being flushed regularly. Mag. 1/4×

furnace heated in the 900 to 1250°F. range, the lower temperature requiring longer times in accordance with code requirements. Field thermal stress relief is accomplished using a radiant flame for complete digester heatings. For localized stress relief, induction heating is utilized. Figures 22 and 23 illustrate shop and field stress relief setups used for digesters.

Peening of deposited weld metal is also used for relieving welding stresses. Its primary purpose is to promote plastic strain in the reverse direction of the strain set up by the contraction of the weld metal. It is doubtful if the weld metal is elongated enough to reduce the residual stresses substantially without excessive work hardening. To be effective, peening must be applied uniformly over the entire area and considerable skill is required to distribute the blows as uniformly as possible to prevent localized overpeening and work hardening and/or flaking and cracking. It should not be done on the first and last pass and should

Fig. 22. Lower cone of digester entering shop stress relief furnace

Fig. 23. Field stress relief setup making use of induction heating for a girth seam of an alloy lined kraft digester

be accomplished at as high a temperature as possible. Peening should be preceded by a thorough cleaning operation to prevent entrapment of slag or flux. It is not recommended to apply peening of the longitudinal and circumferential seams of a new digester as a means to reduce stresses. However, field repairs present a different problem. If it is impractical to apply heat for stress relieving, it is recommended to perform a slight amount of peening to help reduce the stresses.

When overlay work is being done with carbon steel rods, it is recommended a certain amount of peening be done at as high a temperature as possible to help reduce the stresses. Recommendations for peening are given in Appendix G of the API-ASME Code, 1951 Edition.

Radiography of the weld seams permits a higher seam efficiency according to present-day codes. This permits the designer to use thinner plate with accompanying reduced cost, but this does not necessarily offset the cost of preparation for radiographing.

A radiograph merely permits a visual review of the deposit and metal adjacent to it. Code requirements permit a stated amount of porosity and inclusions for a given length provided they do not exceed a certain total area. Undercutting, lack of penetration, and cracks are not permitted to exist in any weld and repairs are necessary. Standards of radiography of the ASME and API-ASME Codes are employed. Other nondestructive testing methods for weld inspection such as magnaflux and fluid penetrant testing are sometimes employed in addition to radiography but require special surface preparation for proper interpretation of indications.

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This paper is a summary of the discussion held at the 1955 meeting of TAPPI prepared by L. G. Pfeiffer of the A. O. Smith Corp. of Milwaukee, Wis. Working closely with Mr. Pfeiffer in the preparation of the paper were H. O. Teeple of the International Nickel Co., Stephen J. Baisch of the Thilmany Pulp & Paper Co., and Merrill A. Scheil and Erwin H. Schmidt, both of the A. O. Smith Corp.

Contributing to the discussion in addition to those mentioned above were: H. M. Canavan, Mutual Boiler & Machining Insurance Co.; W. J. Darmstadt, The Babcock & Wilcox Co.; R. Davis, Chicago Bridge & Iron Co.; L. DelaGrange, West Virginia Pulp & Paper Co.; J. Goss, Gaylord Container Corp.; H. Harris, Jr., Union Bag & Paper Corp.; E. Hopper, Crucible Steel Co. of America; L. Keay, Lukens Steel Corp.; E. Keith, Penobscot Fibre Co.; J. B. Morrison, Crucible Steel Co. of America; A. R. Myer, Graver Tank & Manufacturing Co.; W. Parker, Hartford Steam Boiler Inspection & Insurance Co.; R. Pennington, Jr., National Container Corp.; N. Shoumatoff, West Virginia Pulp & Paper Co.; C. W. Smith and E. Smith, Crossett Paper Mills; E. F. Tucker, Stebbins Engineering & Manufacturing Co.; R. P. Whitney, Institute of Paper Chemistry; J. M. Wilcox, Electric Steel Foundry Co.; and J. Wilkinson, Champion Paper & Fibre Co.

Effect of Smoothness and Compressibility on the Printing Quality of Coated Paper

WALTER W. ROEHR

Among the characteristics of coated book paper which influence its printability are such properties as surface smoothness and compressibility. Several new techniques for evaluating these properties are described. An SA-2 Brush surface analyzer is used for making roughness determinations. The test strip is mounted on a rotating drum and its surface traced with a small diamond stylus, the vertical motion of which is magnified and recorded. An electronic counter has been devised which counts both the number of surface depressions as well as their average width. Depressions shallower than any predetermined depth are automatically excluded. A good estimate of the per cent of total surface area falling below any given depth can be obtained in this manner. For compressibility measurements an apparatus has been constructed which will accurately measure the thickness of a piece of paper at any compressive force up to 1000 p.s.i. Several applications of these techniques to the study of surface roughness and compressibility as they affect printing quality are described. On coated book papers a good correlation is indicated between letterpress halftone prints and surface roughness values. Compressibility appears to play only a minor role on heavily coated papers, but becomes increasingly more important at lower coat weights. Both smoothness and compressibility also have a pronounced effect on rotogravure printability, while offset lithography is the least critical in this respect.

It is the printer's job to transfer to the paper surface the most accurate reproduction of the original object that is economically possible. If, in the printing operation, some of the highlight dots fail to print, either wholly or in part, the delicate tonal gradation will be destroyed, and the print will take on a grainy appearance. If excessive pressure is required in order to print all the dots, a squeezing out of the ink may occur in some other areas, again destroying the tonal gradation and causing a muddy appearing print.

One of the factors which determines the relative printing quality of coated book papers is the faithfulness with which highlight areas can be reproduced at reasonable printing pressures. It is generally acknowledged that surface smoothness and compressibility of the paper are the two most important factors in determining halftone printability.

Means for measuring these properties and determining their relative importance from a printing standpoint has been the subject of numerous investigations (*1–6*). These studies have resulted in the development of a number of instruments designed to measure the relative "smoothness" of paper samples. Some of these testing procedures involve actual printing, others are based on either the air flow, optical, or stylus principle. The results obtained by the different methods occasionally disagree with each other, as well as with actual printing experience. This is to be expected if the smoothness, as defined by a particular testing instrument, differs appreciably from the "printing smoothness" which determines halftone printability.

The instrumentation described below was designed in an effort to provide means for studying some of the surface properties of coated printing papers. Data are presented to give some indication of the extent to which surface smoothness and compressibility vary with different types of paper. The relative importance of these properties is shown to depend on the method of printing employed.

INSTRUMENTATION

Surface Roughness Analyzer

The instrumentation used for the measurement of paper surface roughness is shown in Fig. 1. The basic equipment consists of a Brush SA-2 surface analyzer (*7*). This includes a type PA-2 pickup arm (B) which is equipped with a spherical diamond tracer point having a radius of 0.0005 in. The motion of this tracer point as it follows the contour of the test surface (C) actuates a piezo-electric crystal located in the pickup arm. This crystal, in turn, generates a voltage which is proportional to the vertical motion of the stylus. A relatively large positioning shoe, located just behind the diamond point, carries the weight of the pickup arm and serves to establish a reference level for the moving point. The calibrating amplifier (D) magnifies the output of the pickup, which is then continuously recorded on a moving paper chart by the direct inking oscillograph (E).

During the early stages of this work a considerable amount of data was accumulated whereby the output of the amplifier was fed into a root-mean-square voltmeter. It was hoped that the numerical values thus obtained would show a correlation with printing properties. This attempt met with indifferent success, primarily because such an r.m.s. measurement includes innumerable low-amplitude variations in sheet surface, which are too shallow to have ony significant effect on halftone reproduction.

A comprehensive study of chart tracings in comparison with letterpress halftone prints was made on numerous test samples. This indicated that the ease with which highlight dots can be printed depended primarily on the size and number of the deeper depressions in the paper surface. Since chart analysis is a slow and tedious procedure, an electronic counter was designed which would do the job automatically. This unit is shown at F in Fig. 1 and is equipped with two banks of Berkeley counters. The group of three counters in the upper right hand corner serve to count the actual number of depressions. They are controlled by an electric dis-

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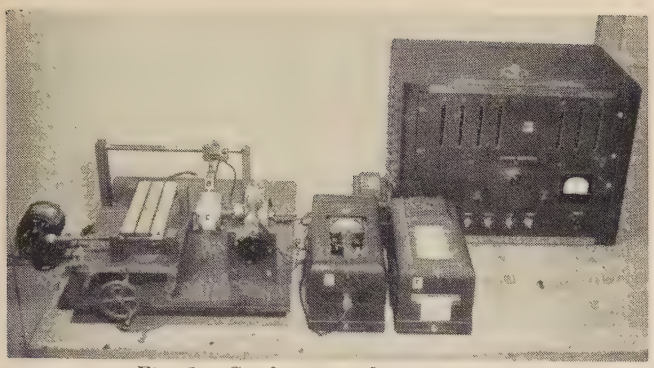

Fig. 1. Surface roughness tester

criminator and will register a single count whenever the Brush tracer point drops below any predetermined depth. Shallower depressions are not recorded. The group of four counters in the upper left hand corner are activated by a 1000-cycle oscillator, but will count only during the period when the tracer point is below the specified depth. These data provide a means for determining depression widths.

All tests are run for a period of 1 min. The counting units are started with a single push button on the panel board and are automatically shut off after 60 sec. by a built-in timing device.

The three bars shown at A are used for calibrating the instrument. These are brass bars surfaced with a smooth plate of glass. They are pivoted at the back end and ride on an eccentric cam at the other end. The whole unit is mounted on a movable carriage. By loosening the set screw at G, the pickup arm can be moved over to ride on one of these bars. When the calibrating motor is started, the bar oscillates, causing a displacement of the tracer point in the form of a sine wave. The amplitude of this wave varies along the length of the bar, and can be adjusted to any desired value by means of the movable carriage. If the discriminator is now adjusted to the point where the counters just stop, the instrument will record all depressions greater than the above amplitude and ignore all shallower ones.

Paper test strips are mounted on the cylindrical drum at C. With the pickup positioned as shown in the illustration, the rotating drum moves the test strip past the tracer point at the rate of 4.0 in. per min. The over-all low frequency response of this arrangement is limited to depression widths of several hundredths of an inch. This is an important feature, since it eliminates from the measurement any large scale variations or actual shifts in sample thickness.

Compressibility Tester

In order to determine the compressibility of paper samples a new instrument was developed. This tester provides for the application of a wide range of known compressive forces, as well as an accurate means for measuring sample thickness under compression. The pressure application portion is shown in Fig. 2.

In order to provide the necessary rigidity, the various parts are mounted on a steel base, G, which consists of a single piece of channel steel 6 in. wide and 36 in. long. The test sample is inserted between two steel blocks, B and C. Block C is stationary, being fastened rigidly to the base plate. The movable pressure block, B, contains a cylindrical projection 2 in. in diameter which bears against the paper sample and defines the test area. The compressive force is applied to B through the two rectangular tension bars, D and F, which in turn receive their force from the hydraulic jack, E, through a dynamometer bar. This is the cross bar located between E and the dial indicator. The compressive force is determined by measuring the deflection of this bar under load. This deflection is read directly off the dial indicator which is fastened rigidly to the two tension bars with its plunger contacting the dynamometer bar.

The thickness of the test sample under any given load is measured electronically. An oscillating circuit, part of which is located in the aluminum box A, is used for this purpose. The circuit includes a fixed condenser plate, so positioned that when blocks B and C are in contact, the distance between the back surface of block B and the fixed plate is approximately 0.010 in. It is obvious that the spacing between the plates of the variable condenser formed in this manner is determined by the thickness of the paper sample under test. This spacing, in turn, determines the frequency of the oscillating circuit, which can be readily measured with a frequency meter. The instrument can be calibrated by inserting pieces of steel shim stock of predetermined thickness in the sample position and measuring the corresponding frequency of the oscillating circuit. This system makes it possible to measure thicknesses to a precision of ± 0.000002 in. with an accuracy of about ± 0.000025 in.

It is apparent that thickness values can be obtained for a wide range of applied pressures. For example, by taking a series of readings at increasing pressures and then decreasing pressures, one can plot a hysteresis curve for any given sample. Actual sheet density at any compressive force can be calculated if basis weight, as well as sample thickness, is known.

If t_i is the initial thickness, t_c the compressed thickness, and t_s the thickness attained by the sample after the compressive force is removed, the following definitions can be written:

$$\text{Per cent compressibility} = 100\,\frac{t_i - t_c}{t_i}$$

$$\text{Per cent resiliency} = 100\,\frac{t_s - t_c}{t_i - t_c}$$

For the data covered in this discussion, t_i and t_s were measured at an applied pressure of 17 p.s.i. since that is about as small a pressure as can be reliably applied. The compressed thickness, t_c, was determined at 850 p.s.i., a value reasonably close to the pressures employed in letterpress printing.

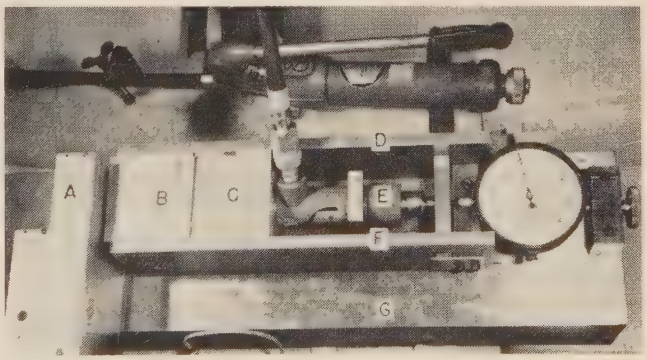

Fig. 2. Compressibility tester

EXPERIMENTAL RESULTS

The diagrammatic sketch in Fig. 3 is a reproduction of a series of typical Brush tracings. Magnification is approximately 660× in the vertical direction and 22× in the horizontal direction. The actual length of test sample represented here is 0.15 in. The base paper was a sheet of 48-lb. coating raw stock, to which was applied a two-side coating of 22 lb. Since all three sections are drawn to the same magnification, the improvement in surface smoothness resulting from the coating and supercalendering operations is readily apparent.

If the automatic counters have been calibrated to cut off a depth of 250 microinches by the method previously described, the right hand unit will register a single count every time the tracer point drops into one of the blacked in areas. Meanwhile, the left hand unit will count at the rate of 1000 times per second as long as the tracer point is in one of these areas. If, in addition, the rate at which the point is traversing the test surface is known, a fairly accurate estimate can be obtained of: (1) the number of depressions deeper than 250 microinches per unit length of sample scanned, (2) the average depression width at that depth, and (3) the percentage of the total surface area of the sample falling below the 250 microinch level.

For the sections illustrated in Fig. 3, the base sheet had 15 depressions deeper than 250 microinches, an average depression width of 0.0021 in., with 20% of the surface area below that level. The unsupered coated sheet shows only 10 such depressions with an average width of 0.0008 in. and 7.5% of the surface area below 250 microinches. It is apparent that for this level the supercalendered section has no depressions deep enough to trip the counters.

In one series of tests a group of 20 commercial samples of 80-lb. coated book papers were studied. Ten grades of paper and five manufacturers were represented in this group. Surface roughness measurements were

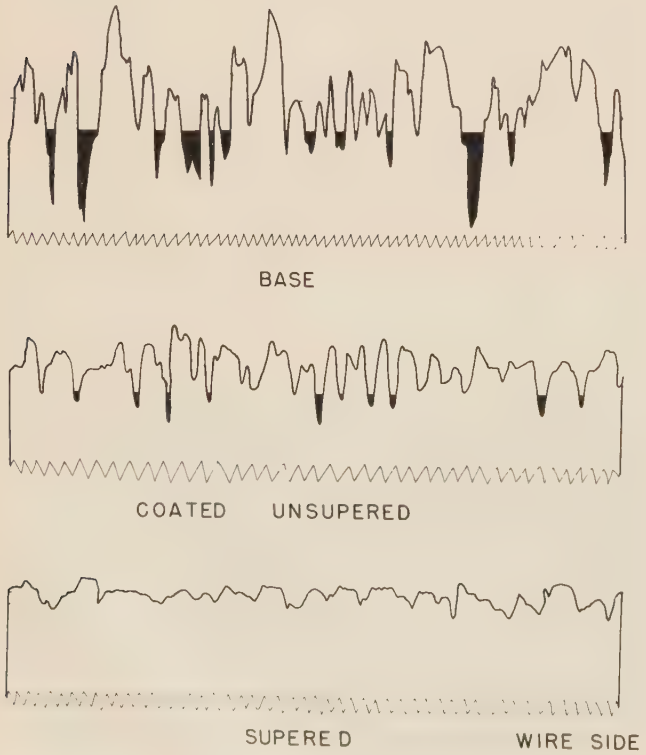

Fig. 3. Brush tracings

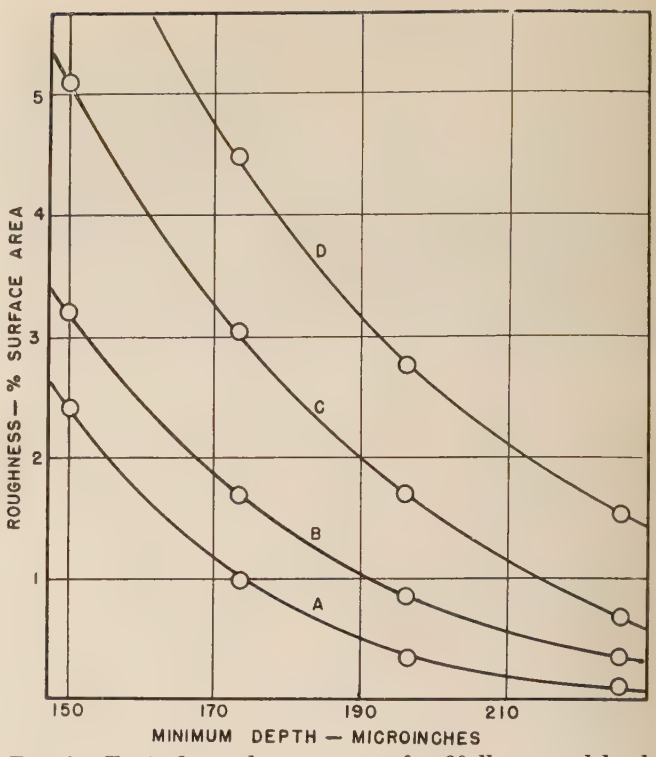

Fig. 4. Typical roughness curves for 80-lb. coated book papers

made with the discriminator set to cut off at various depths ranging from 150 to 225 microinches. Compressibility tests were run according to the procedure previously described. In addition, letterpress prints were made on a Chandler and Price platen press using a 50% tone, 120-line halftone screen. Each sample was printed under identical, carefully controlled conditions, the pressure used being just heavy enough to produce a perfect reproduction on the best printing sheet in the group.

If roughness is defined as the per cent of surface area below 225 microinches, the correlation coefficient between roughness and a visual grading of printed quality was 0.75. If roughness is defined as simply the number of depressions below 225 microinches for any given area, the correlation coefficient was 0.70. There was no significant correlation between compressibility or resiliency and halftone printing quality.

It appears evident that compressibility plays a relatively minor role in the printability of heavily coated, high finish papers of the type described here. Of significant importance is the roughness of the surface, in particular, the number and width of depressions greater than some minimum depth. Figure 4 shows typical Brush analyzer data for four of the twenty samples tested. Test data for these four papers are shown in Table I. Letterpress halftone prints for the same four samples are shown in Fig. 5. Apparently surface de-

Table I

Sample	*Initial thickness, t_i, in. × 10^5*	*Compressibility, %*	*Resiliency, %*	*Roughness, % of area below; 225 microinches*	*175 microinches*
A	432	8.9	83	0.1	1.0
B	433	12.1	77	0.35	1.7
C	409	9.0	82	0.7	3.0
D	400	10.1	82	1.5	4.5

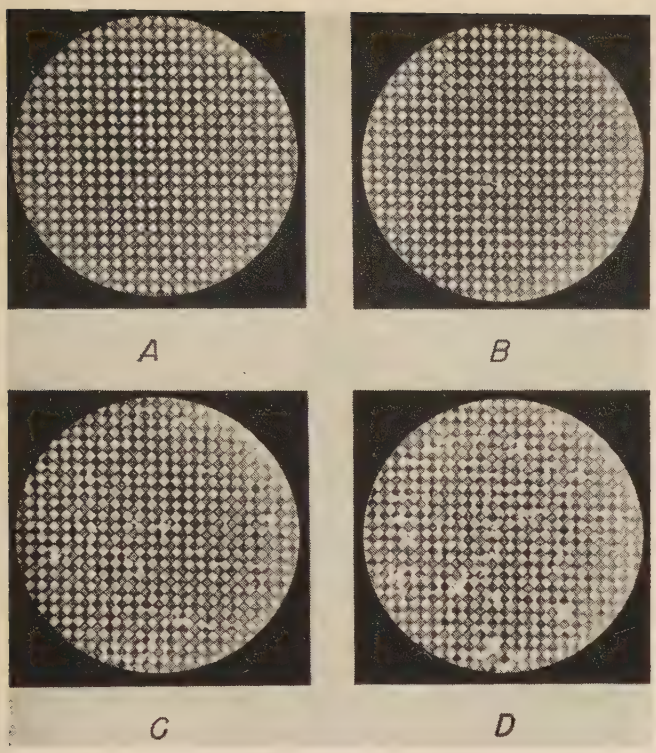

Fig. 5. Letterpress halftones on four samples of coated book paper—120-line screen

pressions less than 225 microinches deep are sufficiently shallow to permit the fluid ink on the printing plate to "bottom" and thus print the individual halftone dots. At greater depths the ink will not "bottom" and a broken dot or skip results. One can readily see from the above how the amount of ink carried on the printing plate can affect the graininess of halftone prints. As the available film thickness decreases, the maximum depth at which the ink will "bottom" decreases, resulting in a greater number of imperfect or missing dots.

Figure 6 shows a reproduction of highlight areas printed on samples A and D by the rotogravure process. In this process a very thin ink is carried in cells etched into the surface of the printing plate. Since there is no layer of ink on the printing surface, the individual cells must actually contact the paper in order to effect transfer. For this reason, smoothness and/or compressibility are of utmost importance in the rotogravure process. Another contributing factor, of course, is the relatively low nip pressures used in this method of printing.

The least critical from the standpoint of paper smoothness is the offset printing process. This is illustrated

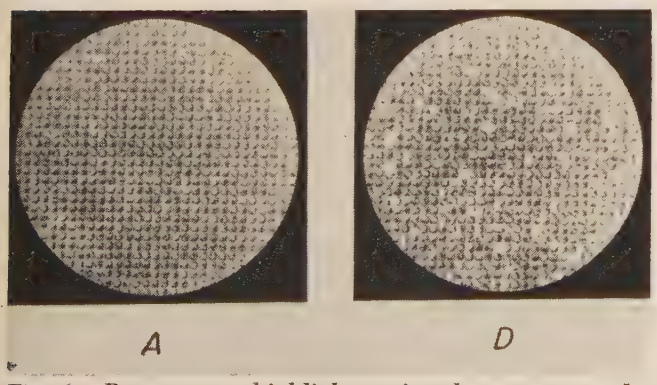

Fig. 6. Rotogravure highlights printed on two samples of coated book paper—150-line screen

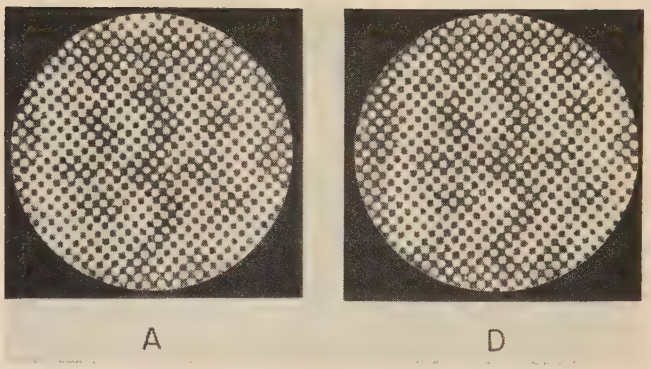

Fig. 7. Two samples of coated book paper printed by offset lithography—150-line screen

in Fig. 7 which shows highlight areas printed by this method on samples A and D using a Lithure tri-metallic plate. Although the reproduction on D is slightly inferior to that on A, the resilient rubber printing blanket has served to compensate for most of the difference in paper smoothness. In the past the use of coarse grained plates by lithographers made faithful reproduction of copy on the plate extremely difficult. With the advent of smooth bi and tri-metallic plates, more perfect dots can be formed on the plate. As further improvements in tone reproduction methods are made, the effect of paper smoothness will become relatively more important.

Figure 8 shows typical Brush roughness data for different types of paper. Sample A is the same 80-lb. coated enamel previously described. E is a highly supercalendered uncoated rotogravure sheet, while F is a lightweight coated publication paper used for heatset letterpress printing. G is a newsprint sheet of the type frequently used for the roto sections in Sunday newspapers. As seen from Table II, these papers represent a considerable range in compressibility. This property depends not only on the amount of calendering the sample has received, but on the coating weight as well.

This is further illustrated in Table III where a 50-lb. base sheet, H, was coated three times. Samples were taken after each coating application. These, along

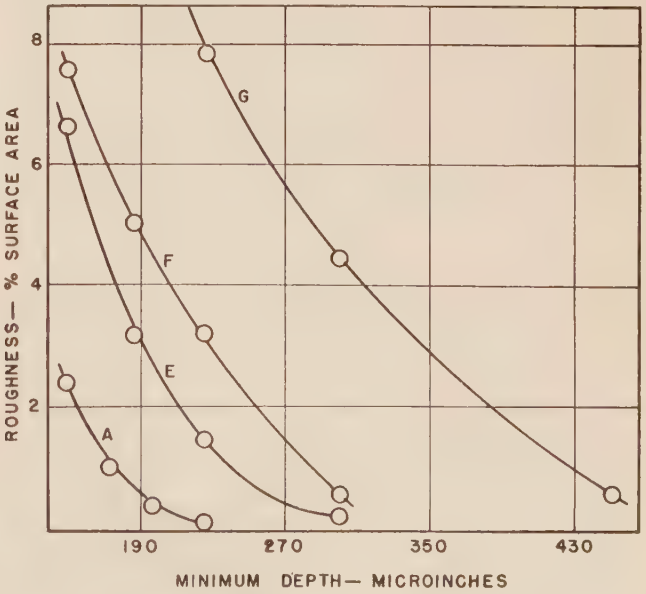

Fig. 8. Typical roughness curves for different grades of printing paper

Table II

Sample	Initial thickness, t_i, in. × 10^5	Compressibility, %	Roughness, % of area below; 300 micro-inches	225 micro-inches
A	432	8.9	0	0.1
E	240	15.2	0.2	1.5
F	242	16.3	0.5	3.2
G	372	30.8	4.4	7.9

Table III

Sample	Basis weight, lb./ream	Weight of coat, lb./ream	Initial, thickness, t_i, in. × 10^5	Compressibility, %	Roughness, % of area below 225 micro-inches
H_0	50	0	349	20.2	3.9
H_1	64	14	361	15.1	1.5
H_2	76	26	397	11.9	0.9
H_3	90	40	427	10.9	0.9

with a sample of the base sheet, were then supered by passing them through six nips of an experimental calender stack. It will be seen that while the smoothness improved with increasing coat weight, the compressibility showed a definite decrease. When this group of papers was printed, the best letterpress prints were obtained on the two sheets with the heaviest coating weight. The best rotogravure print was obtained on the uncoated sheet where high compressibility insured contact with individual cells and lateral migration of the ink produced a smooth tonal gradation.

CONCLUSIONS

The instrumentation described has been found useful in studying the effect of certain sheet characteristics on printing quality. Surface roughness on coated papers shows a reasonably good correlation with letterpress halftones, while compressibility plays a relatively minor role. As coating weights are decreased compressibility becomes an increasingly more important factor in printing quality. One drawback of this method of measuring surface roughness is the time required to scan a representative area of the test sample. It does, however, provide information of a fundamental nature not readily obtained by other means.

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The Beater Addition of Anionic and Cationic Ethyl Polyacrylate Latices

F. C. LEAVITT, W. J. ANDREWS, and V. STANNETT

Ethyl polyacrylate latices prepared in anionic and cationic forms have been added to pulp under controlled conditions. Some of the factors governing the retention of the cationic latex by the pulp have been determined. A number of properties including burst, tear, and folding strengths have been determined at several resin contents for sheets prepared by (1) cationic latex precipitated on to the pulp and (2) anionic latex coagulated by the addition of alum to pH 4.5. In general, greatly superior results were obtained by the use of the alum-anionic latex system.

Industrial mill and laboratory experience has demonstrated (*1*) that in general, poorer properties are imparted to paper by the beater addition of cationic latices rather than anionic. This differs from the case of urea formaldehyde resins and from simple theoretical considerations. It was thought of interest therefore, to check this experience using polymers of similar molecular weight and other properties but prepared as (1) a cationic latex and (2) an anionic latex. An elastomer was chosen which was not of the normal diene type to avoid as far as possible structural differences due to gel content and to enable the retention to be measured by a simple extraction procedure. After some thought, ethyl polyacrylate was chosen as a suitable polymer as it fulfilled the above conditions and some interest had been expressed in its use as a beater additive (*2*).

F. C. Leavitt (Monsanto Fellow 1953–54); W. J. Andrews and V. Stannett, State University of New York College of Forestry, Syracuse, N. Y.

PROCEDURE

Stable emulsions of ethyl polyacrylate were prepared after considerable experimenting using the following recipe and conditions:

Ethyl acrylate	100 grams
Distilled water	300 grams
Potassium persulphate	0.25 gram
Emulsifier	1.0 gram (varied for some experiments)
Cationic	Arquad 12 (Armour)
Anionic	Triton X-200 (Rohm & Haas)
Conditions:	4 hr. over nitrogen at 50°C.

Under these conditions conversions of more than 99% were obtained in both cases. The intrinsic viscosities of the polymers were determined in toluene at 30°C. and found to be 5.2 (cationic) and 5.3 (anionic).

A. In the preliminary series of experiments involving the study of variables effecting the retention of resin by the pulp, the latex addition was carried out on

a beaker scale. The emulsions, prepared as noted above, were diluted to the desired concentration and slowly added to the pulp slurry of 1.75% consistency. While the resin concentration and pulp freeness were varied, the final consistency of the pulp was held constant at 0.85%.

Cationic latices were precipitated simply by contact with the pulp under gentle agitation for the specified period. Anionic latices were coagulated in a similar manner, but following the latex addition to the slurry, the pH was lowered to 4.5 with a solution (2.5%) of alum. No retention was obtained when pulp was mixed with an anionic latex without the accompanying alum addition.

B. The latex addition in the second series of experiments, which involved actually forming handsheets and testing their physical properties, was carried out in a similar manner but on an appropriate scale. Handsheets were formed using a British standard circular sheet mold.

The pulp used was unbleached kraft (southern pine). It was beaten in a Valley laboratory beater to the desired freeness according to TAPPI Standard T 200 m-45. To enhance the response of the pulp to the resin, a Canadian Standard freeness of 600 ml. was used.

The retention was determined by the wet extraction method (*3*) using dioxane as the solvent.

Prior to subjecting the sheets to the various tests noted in the subsequent section, they were placed in a forced draft circulating oven for a period of 15 min. at 180°C. Although this is a very high temperature, it was found by experimentation that these conditions resulted in maximum strength properties for the treated sheets. It was further noted that there was no significant change in the strength properties of the untreated sheets on curing and it was therefore concluded that any change in the strength properties of the treated

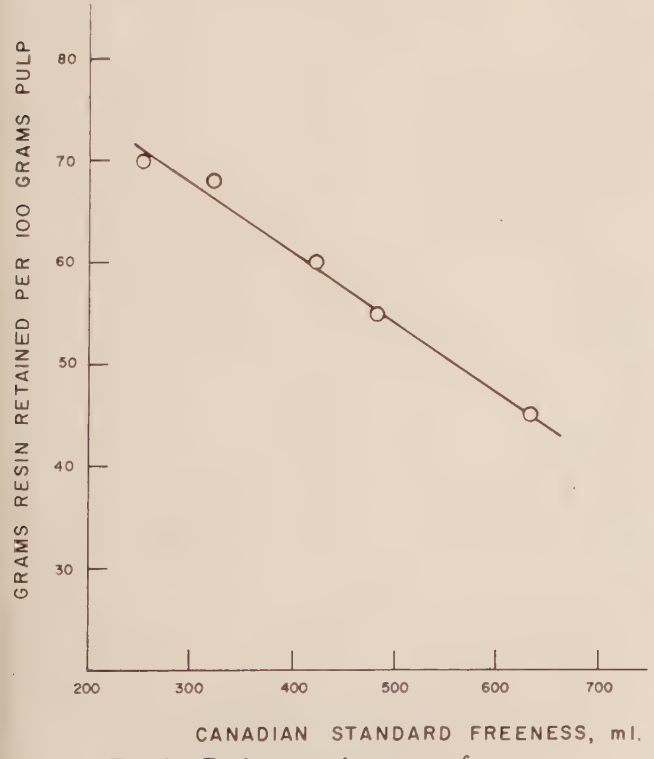

Fig. 1. Resin retention versus freeness

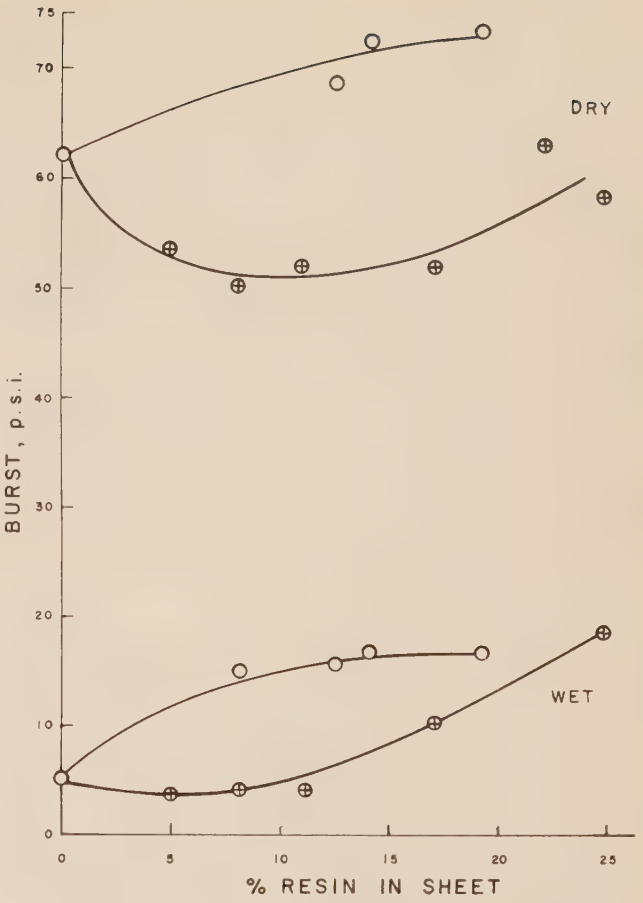

Fig. 2. Bursting strength versus resin content
○—Anionic ⊕—Cationic

sheets from those of the untreated sheets was solely attributable to the presence of the ethyl polyacrylate.

Paper Testing

The cured sheets, both treated and untreated, were subjected to the following physical tests after proper conditioning (TAPPI Standard T 402 m-49):

Burst. Wet and dry. This test was carried out according to TAPPI Standard T 403 m-33. The sheets used for wet burst were placed in water for 12 hr. at 23°C. and on removal the excess water was wiped off and the sheet tested.

Tear. This was determined according to TAPPI Standard T 414 m-49

Tensile. This was determined according to TAPPI Standard T 404 m-50

Fold. This was determined according to TAPPI Standard T 423 m-50

Table I. Ethyl Polyacrylate (EPA) Retention as a Function of the Proportion Added

EPA added,[a] *g./g. dry pulp*	*EPA retained, g./g. dry pulp*	*Retention, %*
0.128	0.118	90.5
0.215	0.200	93.0
0.341	0.330	96.5
0.605	0.425	70.0
0.895	0.495	55.5
1.270	0.502	39.7

[a] As a 14.6% EPA emulsion with 1% (based on EPA) lauryl trimethyl ammonium chloride as an emulsifier. (Arquad 12.)

Fold. This was determined according to TAPPI Standard T 423 m-50 using an MIT folding tester.

Water absorptiveness. This was determined according to TAPPI Standard T 441 m-45 using a 30-sec. exposure period.

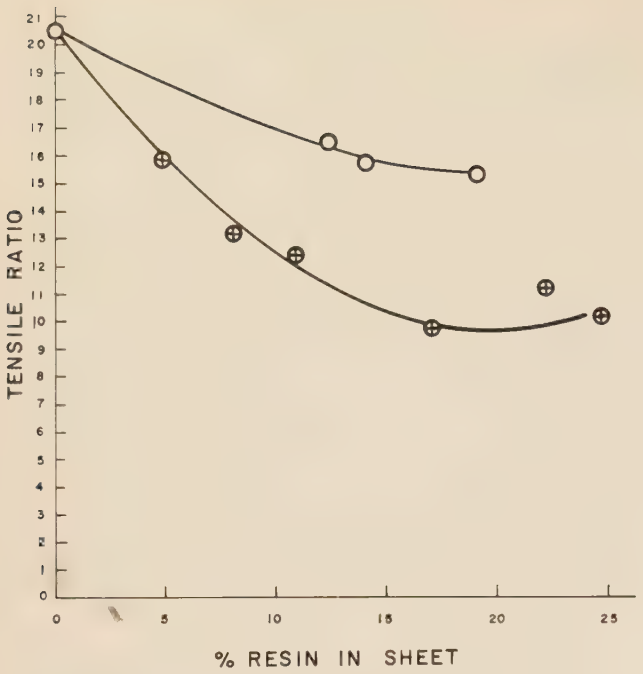

Fig. 3. Dry tensile ratio versus resin content

○—Anionic
⊕—Cationic

FACTORS INFLUENCING THE RETENTION OF CATIONIC LATICES

Some of the variables involved in the precipitation and retention of polymers from their cationic latices were first investigated and the following results obtained.

Ratio of Latex to Pulp

The percentage of elastomer retained by the pulp increased steadily as the latex-pulp ratio was increased until the sheet contained about 33% of elastomer when the amount retained leveled off. The percentage retention rose to about 96.5% at 34% addition on the dry weight of pulp and then steadily declined. The figures obtained are given in Table I.

Effect of Pulp Freeness

It was found that a linear relationship existed between the amount of ethyl polyacrylate retained and the freeness of the pulp used throughout the range investigated (250 to 630 ml. C.S.F.). The effect is shown clearly in Fig. 1. The specific surface of kraft pulp is also linear with freeness in this range (*4*). It is probable that as a larger surface area of the pulp exposed by beating, the greater electrokinetic potential which results causes the increased retention.

Effect of Dissolved Salts

It was noticed during early experiments that the filtrate from simple pulp slurries could sometimes coagulate the cationic latex. Consequently, well washed pulp was used for all the experimental work reported in this investigation. Premature coagulation of part of the latex in the body of the pulp fluid by dissolved salts could possibly account for some of the poor results obtained with cationic latices. In addition, electrolytes could be expected to cause a reduction in retention from ionic strength effects subduing the electronegative character of the pulp suspension in water. Some experiments were carried out therefore on the effect of dissolved sodium sulphate on the retention. The results are recorded in Table II. The retention is seen to be reduced by the presence of the dissolved electrolyte.

Table II. Ethyl Polyacrylate (EPA) Retention—Effect of Soluble Salt Content in Pulp Slurry

Salt content, g./g. dry pulp	*EPA retained,*[a] *g./g. dry pulp*
0.0000	0.599
0.0083[b]	0.478
0.0174[b]	0.490
0.0343[b]	0.498
0.0266[c]	0.495

[a] 0.7 g. EPA per g. dry pulp was added in each run.
[b] Na_2SO_4 added to the pulp slurry prior to the latex addition.
[c] Soluble salts leached from the pulp (unbleached kraft).

Table III. Ethyl Polyacrylate (EPA) Retention—Effect of Latex Emulsifier Content and Contact Time

Emulsifier,[a] *%*	*EPA retained,*[b] *1 min.**	*g./g. dry pulp, 5 min.*[c]
1.0	0.704	0.820
2.0	0.564	0.743
2.5	0.481	0.784
3.5	0.480	...
5.0	0.449	0.527

[a] Per cent lauryl trimethyl ammonium chloride based on ethyl acrylate.
[b] 1.15 g. EPA/g. dry pulp added.
[c] Time of contact.

Effect of Time of Contact and Emulsifier Content

A number of experiments were run in which two times of contact were used with latices in which the emulsifier content had been varied between 1 and 5%. The results are given in Table III. It can be seen that about a 15% increase in retention was obtained by increasing the contact time five fold. Increasing the emulsifier content resulted in a decrease in the per cent retained.

MECHANISM OF DEPOSITION

The fact that a large percentage of the latex is pre-

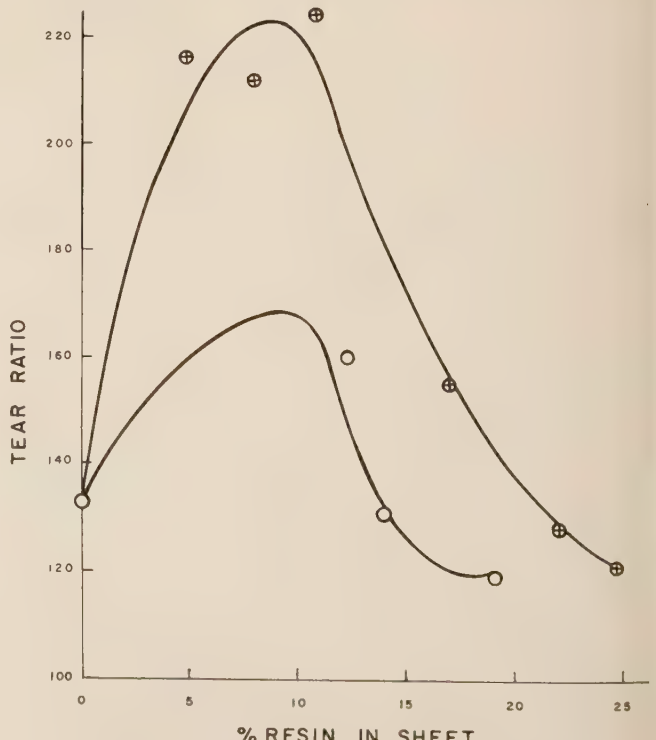

Fig. 4. Tear ratio versus resin content

○—Anionic ⊕—Cationic

Table IV. Cationic and Anionic Ethyl Polyacrylate Treated Sheets by Saturation

Latex used	*Resin retained, %*	*Burst strength, p.s.i.* *Dry*	*Wet*	*%*
None	None	51	3.9	7.6
Cationic	14.3	71	28	39.9
Anionic	14.7	70	28	40.0

cipitated by the well washed fibers when no precipitation occurs with a comparable anionic latex indicates that electrostatic forces are involved. The effect of soluble salts and increasing the surface area of the pulp by beating are also indicative of this mechanism. A latex containing a greater emulsifier content shows a substantial reduction in retention indicating that the stability of the latex is also involved. A simple picture of the mechanism would be that because of the large surface area presented by the pulp fibers, collisions between the latex particles and the fibers are frequent. The opposite charge carried by the fibers tends to destroy the stability of the latex particles and they are deposited. A microscopic examination of the treated pulp shows the precipitated resin particles to be quite large compared to the uncoagulated particles, and therefore, many particles must have come together to produce this size. This is normal to emulsion coagulation theory where the larger particles tend to add to smaller latex particles giving rise eventually to tiny pieces of

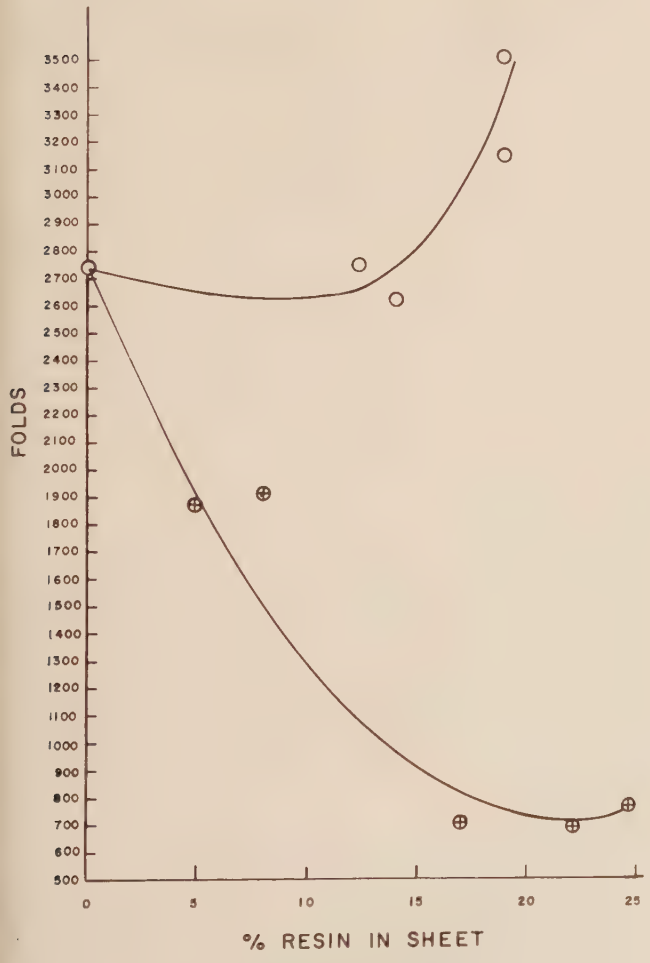

Fig. 5. Fold ratio versus resin contact

○—Anionic
⊕—Cationic

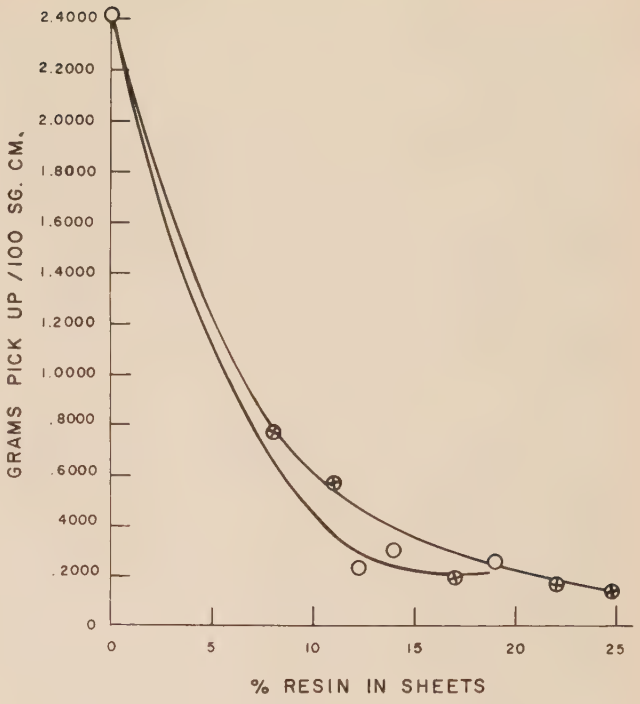

Fig. 6. Cobb size versus resin content

○—Anionic
⊕—Cationic

coagulum. The higher emulsifier content of the latex, the more stable it becomes and consequently, the less efficient are the fiber-latex particle collisions in causing precipitation. Some mechanical breaking of the latex may be involved as high rates of stirring gave higher retentions however extremely gentle stirring conditions were used in the work reported and it is thought that nearly all of the retention was brought about by an electrostatic type of coagulation.

A COMPARISON BETWEEN THE PROPERTIES OF CATIONIC AND ANIONIC LATEX TREATED SHEETS

Before carrying out the beater addition work, some simple saturation tests were carried out to the same resin content using (1) the cationic and (2) the anionic latex. The results are given in Table IV. It can be seen that identical wet and dry burst strengths are obtained in the case of saturation confirming the lack of any basic difference in the resins involved.

A number of handsheets were prepared containing various percentages of ethyl polyacrylate added from cationic and anionic latices as previously described. The sheets were cured and the following properties determined: wet and dry burst strengths, tensile strength, water absorption (Cobb size), tear strength, and folding endurance. These properties plotted against the actual resin content of the sheet for both

Table V. Summary of Differences Between Cationic and Anionic Latex Treated Paper at 10% Resin Content

Test[a]	*Cationic*	*Anionic*	*Difference over cationic, %*
Dry burst	51	69	+ 35
Wet burst	5	15	+200
Dry tensile	12.4	17	+ 37
Dry tear	220	68	− 69
Dry fold	1300	2630	+100
Water absorption	0.60	0.44	+ 27

[a] Tests are corrected for basis weight where relevant.

cationic and anionic cases are recorded in Figs. 2–6. A summary of the data taken at 10% resin content is given in Table V.

It can be seen that greatly superior results are shown by the anionic latex in the wet and dry burst, tensile strength and folding endurance. The Cobb size results were somewhat similar for both systems although the anionic again appeared somewhat superior. In the case of tear strength the cationic was greatly superior. The reverse behaviors of the tear strength is not unexpected as tear frequently decreases as burst and tensile increase. The good tear resistance obtained with small additions of the ethyl polyacrylate is noteworthy.

DISCUSSION

The results show that the general industrial experience with cationic latices is confirmed with carefully controlled laboratory experiments. The reason for the poorer behavior is not clear but must be due to a difference in the distribution of the resin particles in the sheet. The only other difference is the presence of alum in the case of the anionic system. It is difficult to see however how alum could play any role in the actual adhesion of the ethyl polyacrylate to the fibers. A careful microscopic examination was made of sheets containing ethyl polyacrylate added using anionic and cationic methods. No obvious differences in distribution were revealed, but further work in this direction is necessary, possibly using the electron microscope. It is probable that an optimum particle size is necessary to bring out the best properties and that the cationic latex precipitates in too fine or too coarse a distribution to be fully effective. In any case the differences are subtle and are not revealed by a careful miscroscopic examination at normal magnifications.*

* Subsequent work in this laboratory has shown clearly the different distributions of resin in the two cases. (Andersson, Bhargava and Stannett—*Tappi*, to be published.)

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Total Pressures for the System: Sulphur Dioxide–Water

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Pressure values for the system sulphur dioxide–water were determined for sulphur dioxide concentrations up to those of the two-phase system and at temperatures up to those corresponding to a gage pressure of 150 lb. Correlation of the data by Plummer's (9) modification of the Othmer (6) method gave a minimum slope lower than that statistically derived by Plummer.

A BIBLIOGRAPHY and critical analysis of pressure data for the sulphur dioxide–water system was published by Plummer (*9*) in 1950. His findings were presented in a statistically derived table of constants for a straight line equation relating the total system pressure to that of water at the same temperature. Although these constants were derived in part by wide extrapolation of experimental data, they are said to be reliable for the calculation of system pressures at temperatures up to 130°C. and at concentrations from 0 to 10 grams SO_2 per 100 grams of water.

Extensive work on the physical properties of sulphite liquors carried out at the Canadian Pulp & Paper Research Laboratories in Montreal has been summarized by Beazley, Campbell, and Maass (*1*). This study covered sulphur dioxide concentrations up to 6% by weight at temperatures as high as 130°C. Higher concentrations were also precisely investigated but at temperatures which did not exceed 27°C. Other investigators cited by Plummer have not exceeded these limits.

Although the authors know of no commercial pulp mill operating at a sulphur dioxide solution concentration substantially above 10%, higher limits are not inconceivable and are certainly of interest for design and experimental purposes. While it is recognized that variables such as digester occupancy, the presence of combined sulphur dioxide and wood chips, and air retained by the wood will prevent exact large scale duplication of the results, this work provides practical data for use in the calculation of approximate gage pressures up to 150 p.s.i. and at sulphur dioxide concentrations higher than those previously reported.

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EXPERIMENTAL METHOD

The apparatus used in this work is pictured in Fig. 1. This consisted of a cylindrical vessel fabricated from type 316 stainless steel and fitted with a pressure gage and valves for sampling and relief. Total cylinder volume was 2500 ml. For the runs a solution volume of 2250 ml. was used to allow a vapor space of 10% at room temperature.

Solutions testing 12 grams SO_2 per 100 ml. and less were prepared by bubbling sulphur dioxide gas into distilled water. The solutions were tested by the Palmrose iodate method (*8*) in the pressure vessel, so that loss of sulphur dioxide after analysis was kept to a minimum. Before the lid was bolted down, the solution was frozen by suspension of the vessel in a carbon dioxide–acetone bath. After the vessel was closed and before the contents were allowed to thaw, air in the vapor space was removed by the application of suction to the relief valve.

For the preparation of solutions testing over 12 volume per cent, liquid sulphur dioxide was used. After a measured amount of distilled water was poured into the vessel, a beaker containing a calculated weight of liquid sulphur dioxide was placed on the three supporting lugs. The lid was then carefully put in place and bolted down. The contents were mixed by inversion

of the cylinder. The small pressure thus generated was utilized to vent air from the system.

At the end of a run, the concentrated solutions were analyzed by an indirect method. A solution of sodium hydroxide of known concentration was brought to the mark in a 500 ml. volumetric flask. A calibrated pipet was then used to remove exactly 100 ml. leaving 400 ml. in the flask. An inverted L-shaped tube attached to valve A was brought below the surface of the sodium hydroxide solution in the volumetric flask, and a sample of sulphur dioxide liquor was drawn from the pressure vessel. The volume of the sample was then determined by refilling the flask to the mark with a measured volume of distilled water, and the weight of sulphur dioxide was calculated after titration of residual alkali with standard acid.

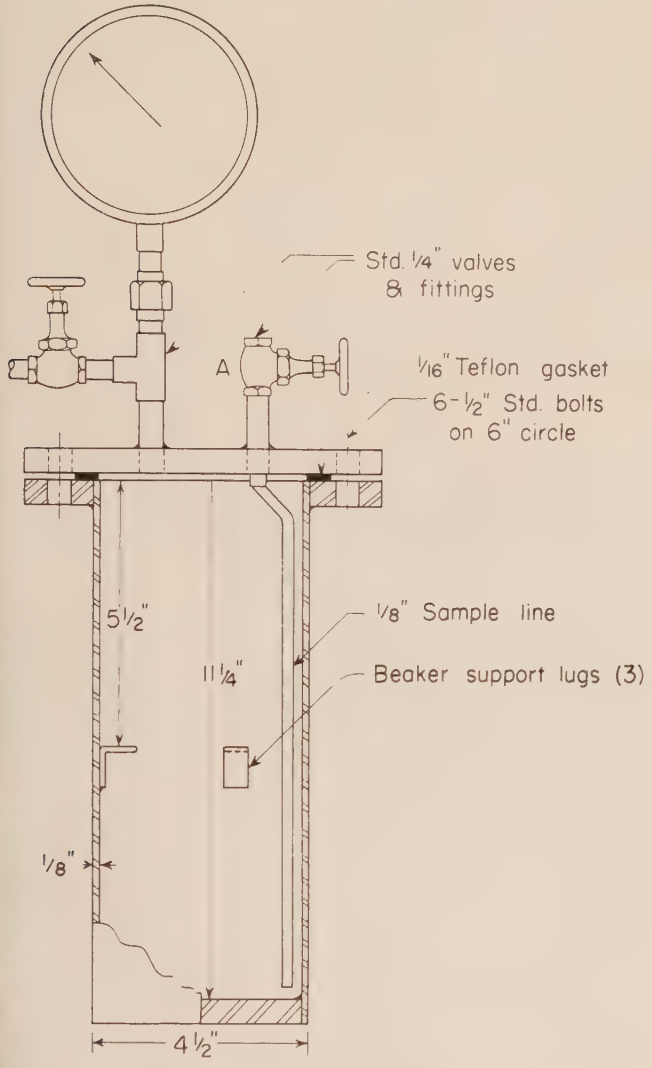

Fig. 1. Apparatus used for measurement of system pressures

For the adjustment of temperature the reaction vessel was placed in a thermostatically controlled water or oil bath. Pressure readings were recorded after no further change took place at a constant temperature measured by a calibrated thermometer placed in the bath. Generally, several hours with frequent agitation were required before this equilibrium was established. The commercial Bourdon tube pressure gages were calibrated on a dead weight gage tester between runs. Care was taken to remove oil from the gage since solubility of sulphur dioxide in oil would have introduced an error. To minimize condensation, the exposed section of line leading to the gage was insulated with glass wool held in place with vinyl tape.

DISCUSSION OF RESULTS

Othmer (*6*) has derived from the Clapeyron equation a straight line correlation for vapor pressure data. In the integrated form this equation is:

$$\text{Log } P = \frac{L}{L'} \log P' + C \qquad (1)$$

in which P, P', L, and L' are pressures and molal latent heats of two different substances at the same temperature. If the ratio of latent heats, L/L', is constant over the temperature range under consideration, a logarithmic graph of the partial pressures at the same temperature will be a straight line with the slope equal to this ratio. Extending the method to study heat effects in solutions, Othmer and White (*7*) obtained straight, parallel lines when vapor pressures of sulphur dioxide solutions of different concentrations were plotted against water as a reference substance. In his critical study, Plummer (*9*) states that the lines shown by these authors actually are slightly curved at low concentrations. He also found this to be true when this method of plotting was applied to the sulphur dioxide solution data of other investigators, particularly at low concentrations and at temperatures above 100°C. When he plotted the total system pressure against water as a reference substance, however, straight lines were obtained in all cases. The slope becomes the ratio of the differential heat of solution of a mixed mol of sulphur dioxide and water to the latent heat of water. The equation is:

$$\text{Log } Pm = b \log p_w + a \qquad (2)$$

in which

Pm = total system pressure at t°C.
p_w = vapor pressure of water at t°C.
b = slope
a = intercept

Plummer's modification of Othmer's method was used to correlate the results of this work. The data, plotted in Fig. 2, form straight lines, the deviations of the points reflecting the precision of the method. As suggested in Othmer's (*6*) original paper, this straight line graph was used as one criterion of the accuracy of the data. For example, in some of the early runs, the points fell below the line at higher temperatures. When the exposed portion of tubing below the gage was properly insulated, condensation was prevented and consistent pressures were recorded.

To check the results of the method against available published figures, the data of Campbell and Maass (*2*) and Gurd, Gishler, and Maass (*3*) were adjusted to a volume basis. Interpolated points are shown on the line for 6.1% SO_2 in Fig. 2. The agreement is within the accuracy of our method.

Two liquid phases are known to separate at a solution concentration of about 25 weight per cent sulphur dioxide at 25°C. (*5*). For the determination of total pressures for this system, the liquid sulphur dioxide method was used to prepare a solution at an over-all

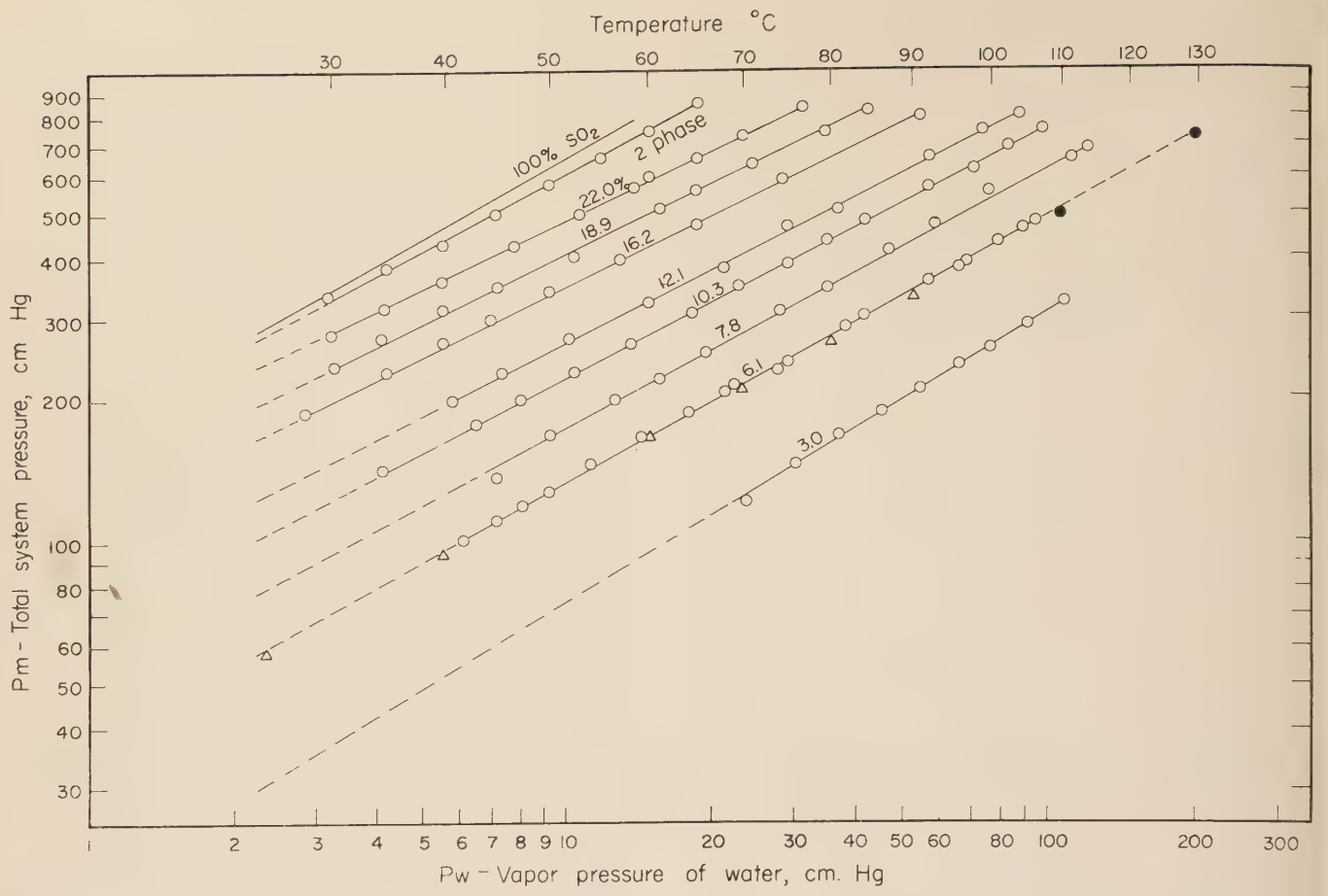

Fig. 2. Total pressures for the system: SO_2–H_2O plotted by Plummer's (9) modification of Othmer's (6) method.

○—this work. △—Campbell and Maass (*2*). ●—Gurd, Gishler, and Maass (*3*).

concentration of 35%. On the logarithmic plot, pressures for this system lie on a straight line slightly below the line for pure sulphur dioxide.

Figures 3 and 4, which express pressure at constant temperature as a function of concentration were constructed by interpolation from Fig. 2. Experimental data were first extrapolated to 25°C., and vertical lines were erected at 5°C. intervals up to 110°C. The intersections of these lines with the curves then gave corresponding total system pressures. Absolute pres-

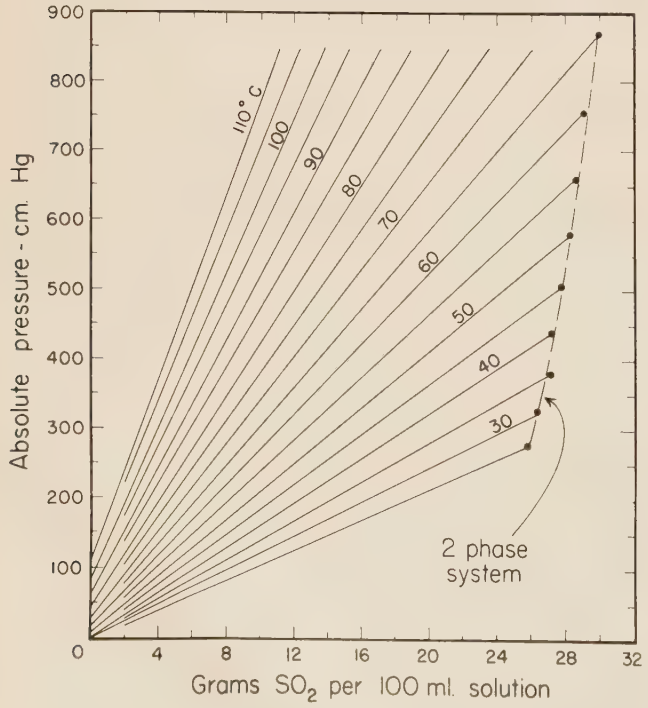

Fig. 3. Absolute pressures for system: SO_2–H_2O

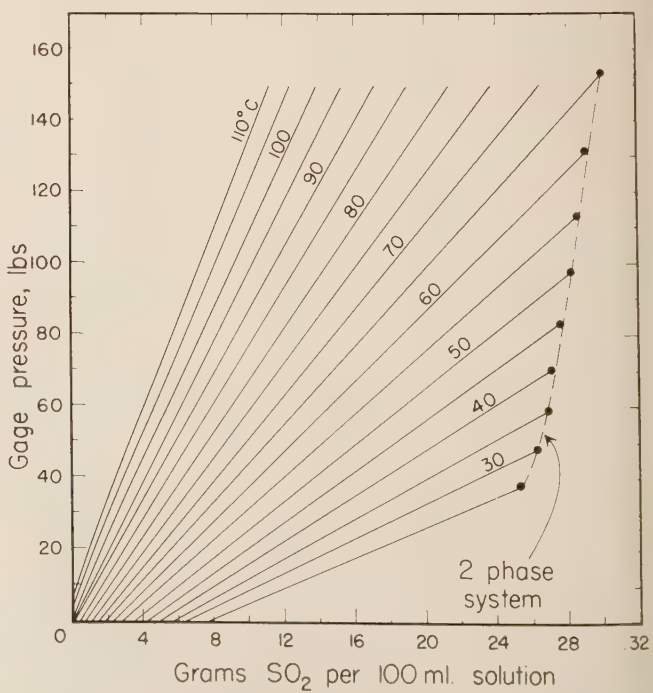

Fig. 4. Gage pressures for system: SO_2–H_2O

TABLE I

Constants in the equation Log $Pm = b \log p_w + a$ in which
Pm = total SO_2–H_2O system pressure at t°C., mm. Hg
p_w = vapor pressure of H_2O at t°C., mm. Hg
a, b = constants

Grams SO_2 per 100 ml. solution	a *intercept*	b *slope*	*Source*
0.03	0.0336	0.9865	(*9*)
0.05	0.0547	0.9805	
0.08	0.0842	0.9751	
0.10	0.1094	0.9681	
0.15	0.1744	0.9518	
0.498	0.6160	0.8282	
0.994	0.9240	0.7600	
1.98	1.2952	0.6832	
2.95	1.5135	0.6473	
3.92	1.6448	0.6438	
4.88	1.7546	0.6358	
5.81	1.8537	0.6260	
7.65	1.9865	0.6250	
9.51	2.0944	0.6183	
3.0	1.65	0.612	This work
6.1	2.00	0.565	
7.8	2.16	0.543	
10.3	2.30	0.526	
12.1	2.40	0.512	
16.2	2.54	0.505	
18.9	2.63	0.491	
22.7	2.69	0.497	
Two-phase (35% over-all)	2.72	0.531	
100	2.68	0.566	(*10*)

sures are plotted in Fig. 3; for convenience these are converted to pounds gage pressure in Fig. 4.

TWO-PHASE BOUNDARY

The two-phase boundary in Figs. 3 and 4 was established by extrapolating each isotherm to its point of intersection with a horizontal line drawn through the two-phase system pressure at the same temperature. C. E. Maass and O. Maass (*5*) have accurately determined the concentration of the water phase to be 25.2 weight per cent sulphur dioxide at 27°C. At this temperature we obtained a concentration in volume per cent of 26.2%, or when converted by extrapolation of the density data of Campbell and Maass (*2*), 23.6 weight per cent. This is a difference of over 6%, but since only limited density data were available for extrapolation, the actual error may not be so great. Concentration of the saturated water phase varies from about 26% at 25°C., to 30% at 65°C.

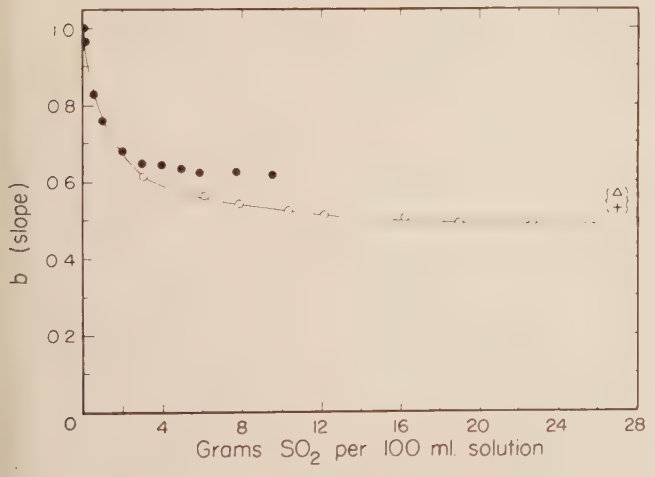

Fig. 5. Slope, b, in equation log Pm = b log p_w + a

○—this work. ●—Plummer (*9*). +—two-phase system. Δ—pure SO_2 (*10*).

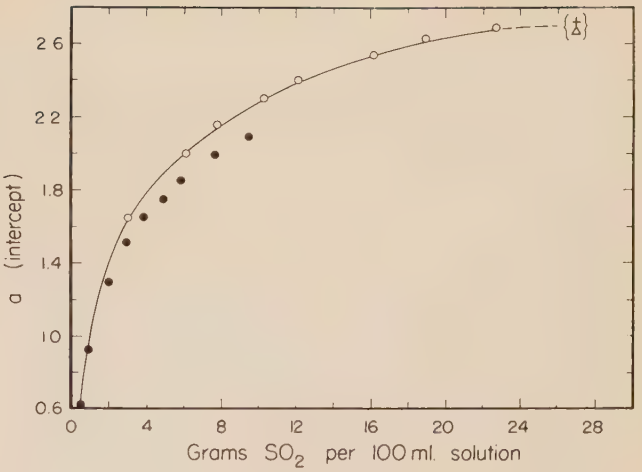

Fig. 6. Intercept, a, in equation log Pm = b log p_w + a

○—this work. ●—Plummer (*9*). +—two-phase system. Δ—pure SO_2 (*10*).

CORRELATION OF VALUES FOR SLOPE "*b*"

In organizing his statistical study of published data, Plummer assumed that the slopes of the lines in the modified Othmer plot lie between unity for water and 0.57 for pure sulphur dioxide. His calculated constants for equation (2) and those derived from Fig. 2 are listed in Table I. [Published concentrations were converted to a volume basis with the specific gravity data in Lange's Handbook (*4*)]. Plotted in Fig. 5, the slope, *b*, reaches a minimum of 0.49 for a saturated solution at 25°C., the temperature at which the solutions were analyzed. This concentration has been shown to be about 26% by volume. The difference between this slope and the calculated minimum of 0.57 can be explained by the limited solubility of sulphur dioxide in water, a fact not mentioned in Plummer's article. Since the concentrations of the two-phase system vary with temperature, this line would not be expected to define the limiting slope. As shown in Fig. 5, the slope for this line is between the observed minimum and the value for pure sulphur dioxide.

Values for the constant *a* plotted in Fig. 6, were calculated from the slopes of the pressure lines. At 26% SO_2, the maximum is 2.7. These constants are presented for their theoretical interest. Pressure values obtained by interpolation in Figs. 3 and 4 are probably more consistent with the precision of the experimental method.

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Polysaccharides Associated with Alpha-Cellulose

G. A. ADAMS and C. T. BISHOP

Alpha-celluloses of cotton, wheat straw, hardwood pulp, and bacterial cellulose were shown to contain small amounts of xylose, arabinose, mannose, galactose, ribose, and rhamnose, in addition to glucose. Crude tunicin (animal cellulose) contained xylose, arabinose, and galactose. Fractionation from cuprammonium solution disrupted the fiber structure of the cellulose and diminished the possibility of any physical association with the pentosan components. Any coprecipitated pentosans were removed from the regenerated celluloses by another treatment with 17.5% NaOH. The purified alpha-celluloses from plant sources still contained pentose sugars with xylose being present in all samples, although in reduced amounts. Total acid hydrolysis showed arabinose to be present in measurable amounts in all samples of cellulose: partial hydrolysis with formic acid released only a trace of arabinose from cotton and none from bacterial cellulose. Formic acid hydrolysis of jute alpha-cellulose yielded arabinose and xylose. Purified tunicin cellulose contained galactose but no pentose sugars. These investigations showed that alpha-celluloses from various sources contain small amounts of sugars other than glucose. Indirect evidence suggests association is due to covalent bonds.

Alpha-celluloses from various plant sources contain small amounts of xylan (*1*, *2*, *3*) and more recently arabinose has been identified in hydrolyzates of many of the same alpha-celluloses (*4*, *5*). Although alpha-cellulose is a fraction of cellulose obtained by an arbitrary procedure and hence of slightly varying composition, nevertheless the consistent presence of small amounts of pentosan materials indicates a close association with the alpha-cellulose. The suggestion has been made frequently that the cellulose and xylan may be combined chemically (*6*, *7*) although there is some evidence that the association may be of a physical rather than a chemical nature (*8*, *9*).

The present study deals with the quantitative composition of four different alpha-celluloses before and after fractionation from cuprammonium solution. Fractionation from cuprammonium solution was designed to disrupt the structure of the cellulose fiber and thus diminish the possibility of any physical association with the pentosan components. The qualitative compositions of two other alpha-celluloses were examined also.

MATERIALS AND METHODS

Celluloses from the following sources were examined: wheat straw holocellulose which had been prepared by the acid chlorite method (*10*); bleached hardwood sulphite pulp; alkali treated cotton linters which had been extracted with alcohol-benzene (2:1), and bacterial cellulose. The latter was prepared by growing *Acetobacter acetigenum* on glucose medium for 10 days, and recovering the cellulose by the method described by Barclay, *et al.* (*11*).

Alpha-celluloses were prepared from the crude celluloses by the 17.5% NaOH method (*12*) and thoroughly dried through solvent exchange with ethanol and ether. These samples are referred to subsequently as alpha-cellulose I.

Chromatographic Methods

All chromatograms were run on Whatman no. 1 paper using the following solvent systems: (A) ethyl acetate : pyridine : water (2:1:2) (B) ethyl acetate: acetic acid : water (4:1:4). Descending flow of solvents was used throughout and control samples of authentic sugars were spotted on the same paper strip on which a hydrolyzate was being examined. Sugars were detected on the papers by aniline oxalate spray.

Total Hydrolysis of Alpha-Cellulose and Analysis of Hydrolyzates

Two-gram lots of the alpha-cellulose were digested in 72% H_2SO_4 for 2 hr. at 20°C. The acid solution was then diluted to 3% concentration with water and refluxed for 4 hr., neutralized with barium carbonate, filtered, washed, and concentrated at 40°C. to about 1.0 ml.

Removal of Glucose

In order to detect small amounts of other sugars, by paper chromatography, the large amount of glucose must be almost completely removed. Two different fermentation methods were used for this purpose: (1) glucose oxidase, (2) yeast. For the former, the following procedure was used: Three hundred milligrams of "Deoxygenase" (a commercial glucose oxidase preparation)* was added to 100 ml. of the sugar solution and incubated with shaking for 20 hr. at 30°C. The gluconic acid formed was neutralized with barium hydroxide solution using phenol red indicator. After filtration, 100 ml. of ethanol was added to precipitate an additional amount of barium gluconate, which was removed by filtration. The filtrate was concentrated and treated again with ethanol; this procedure was repeated until no further precipitate formed. Alcohol was removed at 40°C. and the aqueous solution deionized with Amberlite IR-4B and Amberlite IR-120. The solution was concentrated to about 1.5 ml. and examined chromatographically using solvent A.

The yeast fermentation was carried out as follows: cellulose hydrolyzate (100 ml.) was heavily inoculated with fresh cells of *Saccharomyces cerevisiae* N.R.C. no. Y.7, a strain of yeast known to ferment only glucose. After fermentation at 35°C. for 6 hr., the solution was clarified with 3 volumes of hot ethanol and centrifuged. The alcoholic solution was concentrated at 40°C. and examined chromatographically in solvents A and B.

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* Donated by Takamine Laboratory, Clifton, N. J.

Partial Hydrolysis of Alpha-Cellulose

The method used was essentially that proposed by Das, Chaudhuri and Wareham (*13*). A 2-gram sample of alpha-cellulose was stirred with 50 ml. of formic acid (90%) for 30 min. and then heated under reflux for 15 min. Most of the formic acid was removed by repeated distillation under reduced pressure with water. The residue was taken up in 25 ml. of water, acidified with sulphuric acid to pH 2.0 and heated for 30 min. at 100°C. to destroy any formyl esters. The solution was then deionized with Dowex 2 and Amberlite IR-120 and, after evaporation to 1.5 ml., was examined chromatographically using solvents A and B. For quantitative experiments the sugars were eluted from the paper with water and estimated by the Somogyi method (*14*).

Fractionation of Alpha-Cellulose from Cuprammonium Solution

Five grams of dry alpha-cellulose from each source was fractionated according to the scheme shown in Fig. 1.

Examination of the hydrolyzates of the three fractions recovered from cuprammonium solution showed arabinose and xylose in all fractions with the greatest amounts in the fraction recovered at pH 9.6. Since fraction I (alpha-cellulose II) represented the main cellulose component it was selected for further quantitative study.

EXPERIMENTAL RESULTS

Factors Affecting the Total Hydrolysis Analytical Method

Occasional results in which more arabinose was found in alpha-cellulose II than in alpha-cellulose I indicated that arabinose was being formed during the analytical procedure. Studies of each step in the method showed that the glucose oxidase contained some gluconic acid decarboxylase resulting in the formation of a small

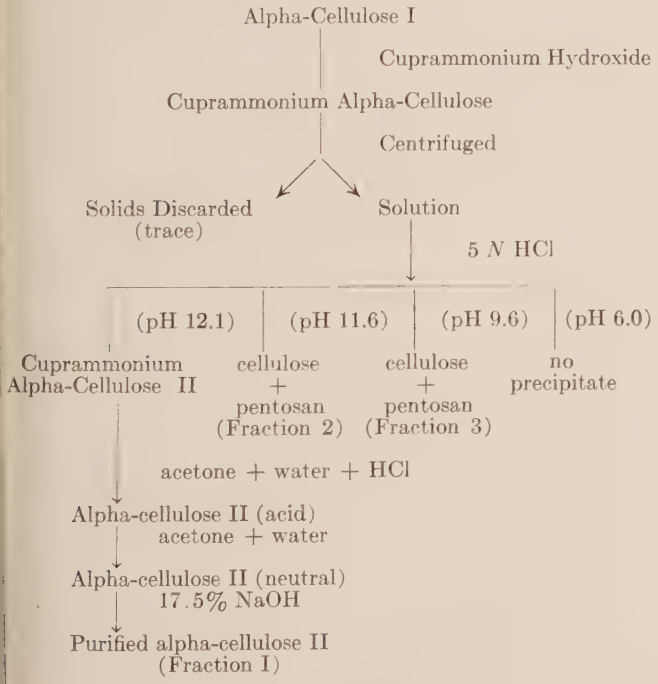


Fig. 1. Fractionation of alpha-cellulose from cuprammonium hydroxide solution

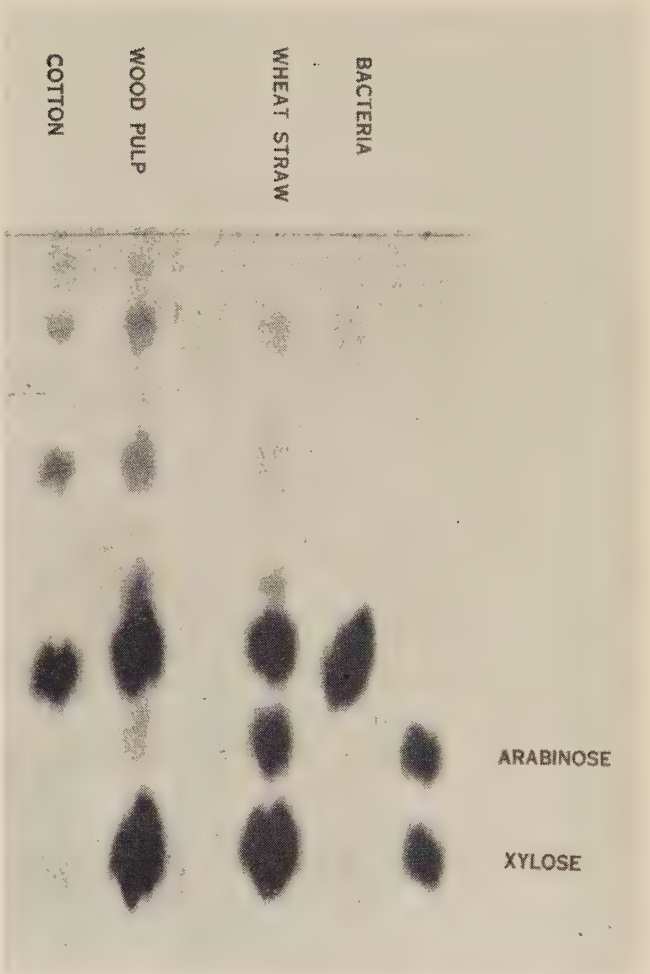


Fig. 2. Chromatograms of hydrolyzates of alpha-celluloses II

amount of D-arabinose. The configuration of the arabinose was confirmed by the isolation of 17.2 mg. of the crystalline sugar (m.p. 158°C.) from a hydrolyzate of 20 gm. of cotton alpha-cellulose. The specific rotation of this sugar ($[\alpha]_D^{25}$ − 48.2) showed it to be a mixture of 73% D-arabinose ($[\alpha]_D^{25}$ − 105°) and 27% L-arabinose ($[\alpha]_D$ + 105). It was apparent that 73% of the arabinose found by the described method was an artifact produced by the glucose oxidase and analytical results were corrected accordingly.

A similar experiment using a formic acid hydrolyzate of 20 gm. of cotton alpha-cellulose showed that all of the arabinose (10.1 mg.) (m.p. 158°C.) was in the L-configuration and therefore was not an artifact.

Pure glucose was subjected to each step in the two foregoing procedures and after recovery was examined chromatographically. Except for glucose oxidase action which produced D-arabinose no other sugars were found.

COMPOSITION OF ALPHA-CELLULOSE

The sugars detected in the sulphuric acid hydrolyzates of the alpha-celluloses I and II are shown in Table I. All alpha-celluloses I showed the presence of the hexoses, galactose and mannose and the pentoses, arabinose, xylose and ribose; in addition wheat straw alpha-cellulose contained rhamnose. Fractionation of the cellulose from cuprammonium removed the hexose sugars, as well as ribose, from cotton and bacteria

Table I. Sugars Present in Alpha-Cellulose I[a] and II[b]

(Cellulose hydrolyzed with sulphuric acid and glucose removed with glucose oxidase)

Cotton		Wood pulp		Wheat straw		Bacteria	
Cellulose I	*Cellulose II*	*Cellulose I*	*Cellulose II*	*Cellulose I*	*Cellulose II*	*Cellulose I*	*Cellulose II*
Galactose	...	Galactose	Galactose	Galactose	Galactose	Galactose	...
Mannose	...	Mannose	Mannose	Mannose	Mannose	Mannose	...
Arabinose	Arabinose	Arabinose	Arabinose	Arabinose	Arabinose	Arabinose	Arabinose
Xylose	Xylose	Xylose	Xylose	Xylose	Xylose	Xylose	Xylose
Ribose	...	Ribose	...	Ribose	...	Ribose	...
...	...	...	...	Rhamnose	...	...	...

[a] Before cuprammonium fractionation.
[b] After cuprammonium fractionation.

cellulose. Mannose and galactose were retained in the alpha-cellulose II of wood pulp and wheat straw. Xylose and arabinose were present in all samples of alpha-cellulose II, although in reduced amounts. The yields of arabinose and xylose in cellulose I and II are given in Table II. There was a decrease in both the xylose and arabinose of all samples of cellulose II with the decrease in xylose being somewhat greater than that of arabinose. Bacterial cellulose was least affected by the purification procedure with cuprammonium.

The cuprammonium treatment followed by 17.5% NaOH digestion was not repeated on any cellulose samples as yields after the latter treatment were greatly lowered, being of the order of 60%. Repetition would cause sufficient degradation to effectively solubilize the greater part of the cellulose molecule.

Chromatographic examination of the hydrolyzates from which the glucose had been removed by yeast fermentation also showed the presence of xylose and arabinose in all samples of cellulose II. Yeast fermentation of pure glucose solutions did not yield any monosaccharides.

Partial hydrolysis of cellulose I and II by formic acid showed that they had approximately the same qualitative composition. Slight differences (as shown by Table I) were probably caused by incomplete removal of nonglucose residues by the partial hydrolysis. All samples contained glucose and xylose and in addition the wheat straw and wood pulp showed the presence of galactose. Only bacterial cellulose was completely free of arabinose. The chromatogram of cellulose II is shown in Fig. 2. The slower moving spots are presumably due to di- and trisaccharides. The amounts of the pentose sugars found in the various celluloses II were as follows:

	Cotton	*Wood*	*Wheat straw*	*Bacteria*
Arabinose, %	Trace	0.006	0.028	Nil
Xylose, %	0.012	0.122	0.145	0.015

Special Cellulose Samples

In a search for celluloses which might be pure polyglucosans, two other samples became available for investigation.

Jute Alpha-Cellulose. A sample of this material reported to yield only glucose on hydrolysis (*15*) was kindly supplied by Professor Sarkar. However, as shown in Fig. 3, the chromatogram of the formic acid hydrolyzate clearly indicated the presence of xylose and arabinose in addition to the glucose. The amounts of pentose sugars were much greater than in cotton and bacterial alpha-cellulose.

Tunicin (Animal Cellulose). Crude tunicin was prepared from the mantles of the tunicate *Phallusia mammillata* by the method of Krassig (*16*). Samples of tunicin alpha-cellulose I and II were prepared by the procedures already described. One-gram quantities of each sample were hydrolyzed by formic acid and the hydrolyzate examined chromatographically in solvents A and B. The chromatograms are shown in Fig. 4. Crude tunicin contained xylose, arabinose, and galactose in addition to glucose. In tunicin alpha-cellulose I, the pentose sugars were decreased in amount and in alpha-cellulose II were absent. However, galactose was present in all samples in considerable amount. Tunicin cellulose differed from the celluloses of plants by being free of pentose sugars but in common with straw and wood cellulose contained galactose associated with the glucose units.

DISCUSSION

Although pure cellulose is defined as a β, 1→4 polyglucosan containing no other sugars (*17*) several investigators have shown that xylose and, more recently, arabinose, are closely associated with alpha-cellulose. In this laboratory, xylose and arabinose have been found in the alpha-celluloses of hardwood pulp, wheat, barely and oat straw, and jute fiber (*5*). The quantities of pentose sugars are small and are only detectable by chromatographic methods when approximately 1-gram quantities of cellulose are examined. In the present investigation the sugars were identified by chromatography in two different solvents. However, the presence of L-arabinose in cotton alpha-cellulose was unequivocally proven for the first time by its isolation in crystalline form. No doubt has existed as to the identification of D-xylose in cellulose.

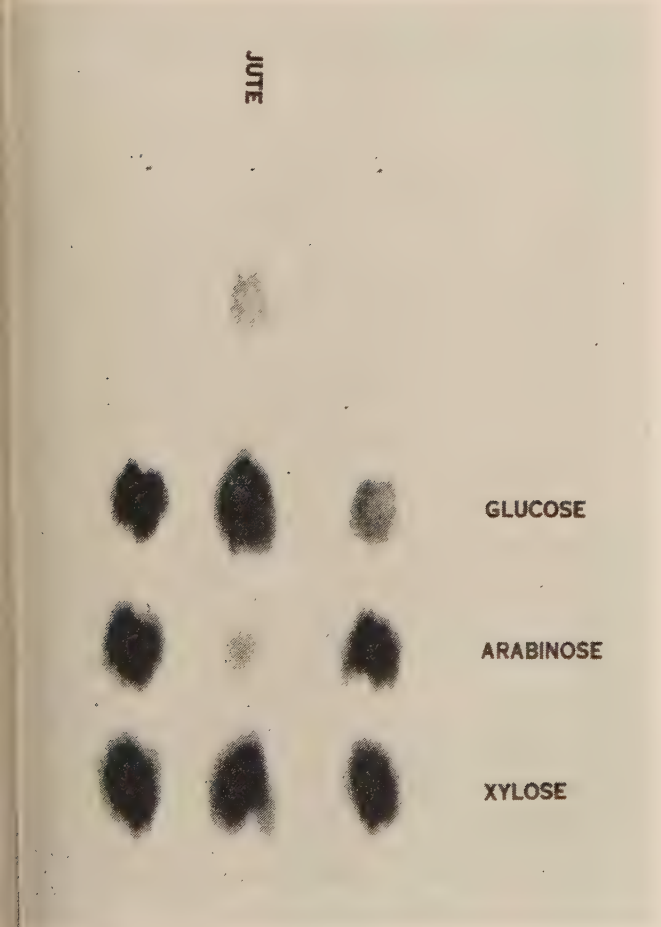
It is still unknown whether the pentosans found in alpha-cellulose are present as physically associated components or as chemically bound constituents of the cellulose molecules. The presence of xylose and arabinose in jute and cotton alpha-cellulose has been demonstrated recently by Das, *et al.* (*4*). Sarkar has disputed Das' claim regarding the pentose sugars and holds that carefully purified jute alpha-cellulose con-

Table II. Pentose Content of Alpha-Cellulose I and II

	Cotton		Wood		Straw		Bacteria	
Alpha-cellulose	*Arabinose, %*	*Xylose, %*	*Arabinose, %*	*Xylose, %*	*Arabinose, %*	*Xylose, %*	*Arabinose, %*	*Xylose, %*
I	0.031	0.042	0.025	0.207	0.106	0.349	0.027	0.012
II	0.021	0.015	0.022	0.112	0.084	0.277	0.021	0.009

tains only glucose (*15*). Examination of Sarkar's purified jute cellulose by methods described above has shown the presence of xylose and arabinose. Das has also reported the separation of a trisaccharide containing xylose, arabinose, and glucose units from jute hemicellulose and hence claimed a chemical union (*4*). We have been unable to find this trisaccharide by repeating Das' experiment although we have found the individual monosaccharides.

The concept of a physical association between glucose and xylose has received considerable support because repeated extraction of cellulose with dilute alkali reduces the pentosan content to a very low level. Moreover, the fact that glucose and xylose units may be accommodated within the same space longitudinally has led to the suggestion by Astbury, *et al.*, that the association may be that of mixed crystals (*9*). Removal of the xylan from cellulose results in sharpening of the x-ray pattern of the fibers (*9*). In the present study the organized structure of the cellulose fibers has been lost by solution in cuprammonium and presumably any xylan, araban, and cellulose molecules which existed in physical association would be separated. Fractional precipitation with acid permitted recovery of cellulose at a higher pH than the pentosan material (*18*). Any coprecipitated pentosan material was removed from the recovered cellulose by treatment with 17.5% NaOH. The loss of hexosan as well as pentosan material during the purification treatments showed that some of these materials were physically associated.



ig. 3. Chromatogram of hydrolyzate of jute alpha-cellulose

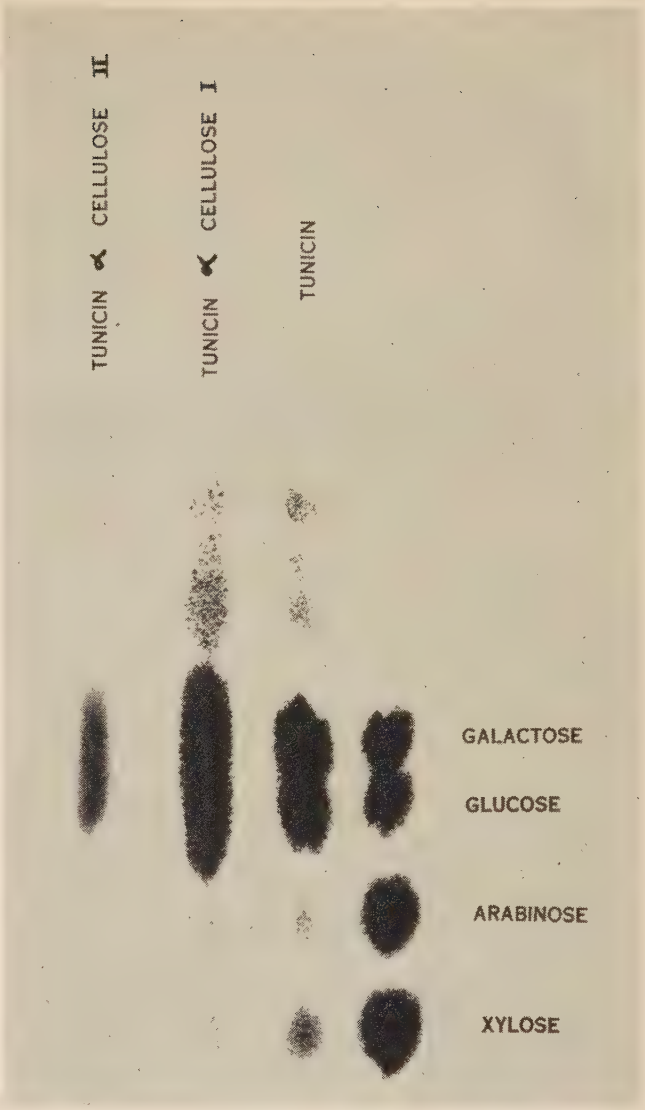


Fig. 4. Chromatogram of hydrolyzates of crude tunicin, tunicin alpha-cellulose I and II

However, small amounts of xylose were retained in all celluloses and arabinose was present in all purified celluloses of plant origin except bacterial cellulose. The persistence of these materials after rigorous purification procedure strongly suggested that some of the original pentosans were chemically combined with the cellulose. The observation that the various alpha-celluloses do not contain the same sugars indicates that they are not identical in their fine structure.

Although the concept of cellulose as a series of chain molecules consisting of β, 1→4 glucopyranose units is unchanged, the chemical union of pentoses or galactose to at least some of the cellulose molecules is strongly suggested. The structure can be verified only by isolation of oligosaccharides composed of glucose and these other sugars.

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Graphic Determination of Roll Deflections

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A simplified and time-saving method of calculating deflections of rolls under load has been developed. This method involves the combining of the known formulas for beam deflections and moments of inertia of roll cross sections, and plotting the resulting equations graphically. By evaluating the ratios of lengths to diameter, inside to outside diameter, and journal length to roll length of a given roll, the deflection can be determined from these graphs. In addition a nomographic chart has been prepared correlating all of the variables affecting the deflection of rolls under uniform load. In an appended discussion, the added deflection of large rolls under heavy load due to shearing stress has been developed, together with graphs for computing this deflection.

The calculation of roll deflections is an important problem which frequently confronts paper mill engineers as well as machine designers. Wherever two or more rolls are run together under pressure, deflection occurs, and it is generally necessary to crown the rolls to give uniform nip pressure.

Crowned rolls are used in the paper machine in presses and calenders, and in converting machines such as coaters, laminators, waxers, gummers, embossers, etc. Even idler rolls deflect under their own weight and the tension in the paper web.

The deflections of rolls can be calculated from standard beam formulas, and these calculations, as related to paper machinery, have been amply treated by previous authors (*1*, *2*, *5*, *7*). It is generally agreed, however, that these calculations are tedious and time-consuming, since they involve third and fourth powers of large numbers. Because differences of fourth powers of numbers of like magnitude are frequently encountered, the use of a slide rule or even logarithms is not sufficiently accurate, making longhand multiplication necessary. These calculations become particularly time-consuming when, in designing a new machine, it becomes necessary to evaluate different combinations of roll diameter and wall thickness to arrive at a proper balance between roll size and deflection.

In order to reduce the effort required to determine roll deflections, a method has been developed which consists essentially of combining the equations for beam deflection and moment of inertia, and plotting the resultant equations graphically. By reference to these graphs and with a few slide rule computations, it then becomes possible to calculate the deflection of a given roll very quickly. The accuracy of the result is believed to be commensurate with the accuracy of most roll grinders and with the values of modulus of elasticity commonly used. In addition, the possibility of arithmetical errors inherent in long computation is greatly reduced.

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SOLID ROLL—SUPPORTED AT HEADS

A simple case of a solid roll with a uniform load across the face width, and supported at the ends of the loaded face, is shown in Fig. 1. In most paper machinery the bearings do not restrict bending, so that this case can be considered as a simple beam, uniformly loaded. The maximum deflection at the center of the roll is then given by the equation:

$$\Delta = \frac{5\omega L^4}{384EI}$$

The moment of inertia of the solid circular section is

$$I = \frac{\pi D^4}{64}$$

Substituting I in the deflection equation:

$$\Delta = \frac{5\omega L^4}{6\pi E D^4}$$

$$\frac{\Delta}{\omega} = \frac{0.265}{E}\left(\frac{L}{D}\right)^4$$

This equation can be plotted for a given value of E using L/D as the ordinate, and Δ/ω as the abscissa and yields a straight line on logarithmic paper. This graph is shown in Fig. 2, and a number of lines have been drawn using values of E for common materials as parameters.

In order to determine the deflection of a given roll using this graph, it is merely necessary to divide the length by the diameter on a slide rule. Referring to the line on the chart corresponding to the material used, a value of Δ/ω is obtained. This is then multiplied by the actual load ω in pounds per lineal inch, to obtain the deflection at that load.

From the machine designer's viewpoint, an inspection of this equation and graph indicate that very slight changes in L or D produce appreciable changes in deflection. Further, in comparing machines and roll

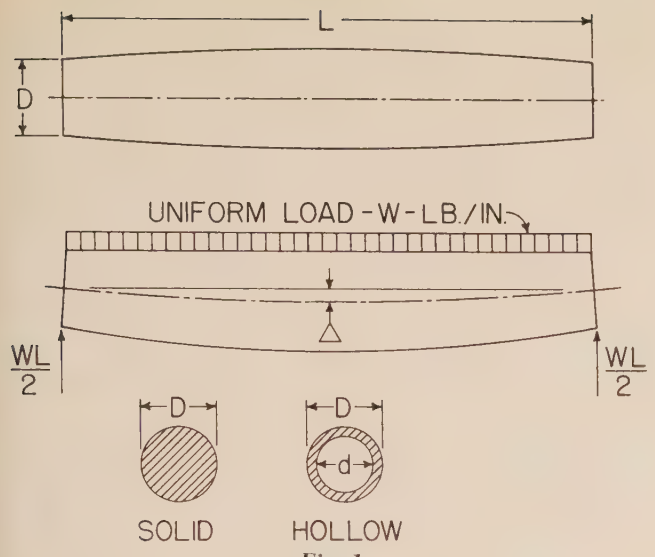

Fig. 1

of different sizes, the deflection will be the same at a given unit load if the L/D ratio is constant.

CORRECTION FACTOR FOR HOLLOW ROLLS

The foregoing equation and graph are limited to solid rolls, whereas most of the rolls used in papermaking and converting equipment are hollow. The moment of inertia of the cross section of a hollow roll is given by the equation:

$$I = \frac{\pi(D^4 - d^4)}{64}$$

which can be rearranged as follows:

$$I = \frac{\pi D^4}{64}\left(1 - \frac{d^4}{D^4}\right)$$

Substituting this in the deflection equation:

$$\Delta = \frac{5\omega L^4}{6\pi E D^4[1 - (d/D)^4]}$$

Let factor

$$A = \frac{1}{1 - (d/D)^4} = \frac{1}{1 - [1 - (2t/D)]^4}$$

Then:

$$\frac{\Delta}{\omega} = \frac{0.265}{E}\left(\frac{L}{D}\right)^4 A$$

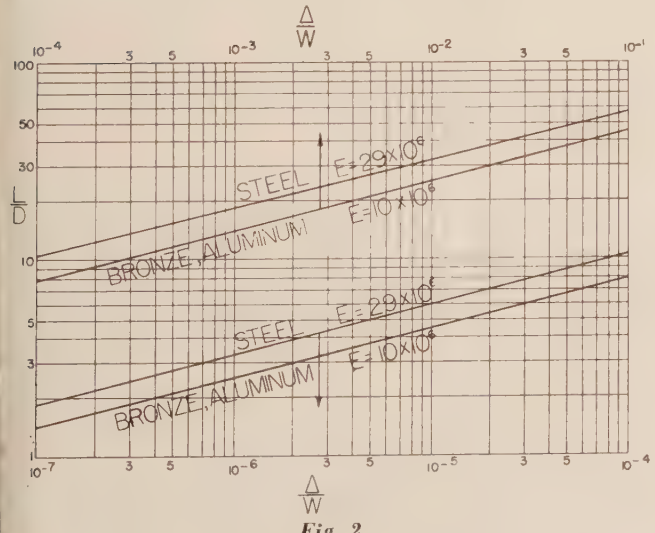

Fig. 2

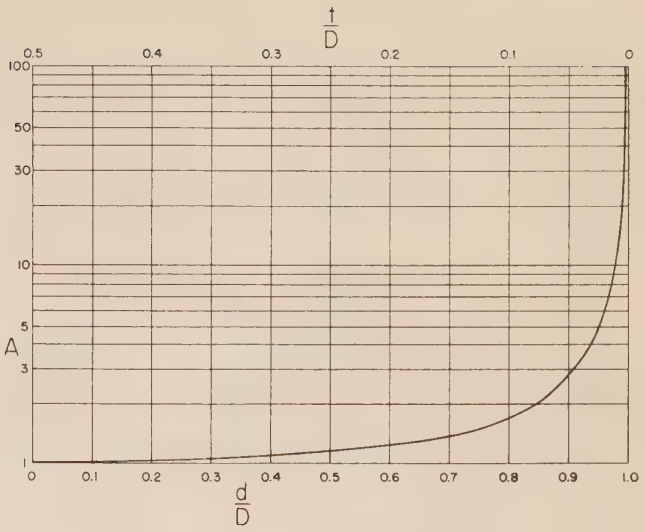

Fig. 3

Thus the deflection of a hollow roll is equal to the deflection of a solid roll of the same length and diameter, multiplied by factor A. This factor is in turn a function of the ratio of inside to outside diameter, or wall thickness to outside diameter. This function has been plotted graphically in Fig. 3.

In order to determine the deflection of a hollow roll, the deflection of a solid roll of the same length and outside diameter is first calculated as above. The ratio d/D or t/D is then evaluated, and the factor A determined from Fig. 3. The solid roll deflection is multiplied by this factor to obtain the actual deflection of the hollow roll.

A study of Fig. 3 indicates that there is very little difference in deflection between solid rolls and hollow rolls up to d/D of about 0.70. Above this value the slope increases more sharply. Thus hollow rolls are generally preferred to solid rolls, since the added metal in the center of a solid roll contributes very little to its resistance to bending. In fact, as will be developed later, the deflection of a roll due to its weight alone will be greater for a solid than for a hollow roll.

On the other hand, the slope of the curve for factor A begins to increase very rapidly above values of d/D of about 0.95. This would seem to indicate that most rolls under moderate loads should be designed with d/D between 0.7 and 0.95, or t/D between 0.025 and 0.15, providing the resulting bending stress is not excessive.

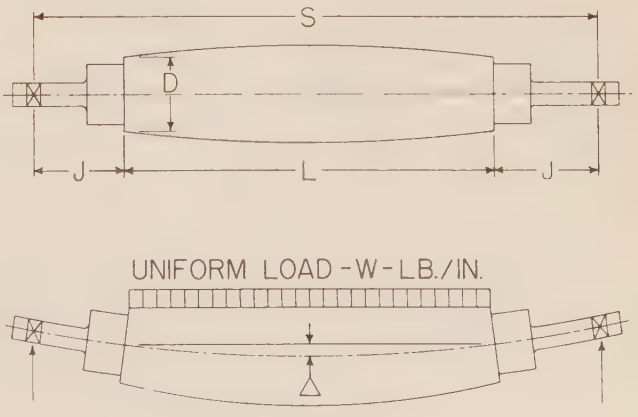

Fig. 4

CORRECTION FACTOR FOR JOURNAL OVERHANG

The foregoing equations and graphs do not take into account the fact that most rolls are supported by bearings located at a distance from the roll heads or the ends of the loaded face, as shown in Fig. 4. This condition has an appreciable effect on the deflection and cannot be neglected. The equation including this effect is

$$\Delta = \frac{5\omega L^4}{384EI}\left(1 + \frac{24J}{5L}\right)$$

The deflection given by this equation occurs between the ends of the loaded face, and does not include the deflection of the journals. This value is the significant figure to be considered when determining crowns. It is interesting to note that the added deflection of the roll face is independent of the journal diameter or cross section.

This equation is surprisingly not found in most handbooks and standard reference books dealing with beam formulas. It has, however, been derived by previous authors in the paper industry (*5*, *7*) and one derivation, using the conjugate beam method, is given in Appendix A of this paper.

To include this effect in the graphic determination of deflection, let factor

$$B = \left(1 + 4.8\,\frac{J}{L}\right) = \left(2.4\,\frac{S}{L} - 1.4\right)$$

This is a simple straight line relationship which has been plotted in Fig. 5. Using the ratio of J/L or S/L, factor B can readily be determined, either from the graph or by direct computation.

The over-all deflection equation is then:

$$\Delta = \frac{0.265\omega}{E}\left(\frac{L}{D}\right)^4 AB$$

$$\frac{\Delta}{\omega AB} = \frac{0.265}{E}\left(\frac{L}{D}\right)^4$$

REVIEW OF PROCEDURE

To summarize the procedure for determining the deflection of a typical hollow roll with overhanging journals, the following steps should be taken:

1. Determine values of ratios L/D, d/D or t/D, and J/L or S/L.
2. Refer to Figs. 2, 4, and 5, respectively, to obtain values of Δ/ω, A, and B.
3. Multiply these three values together and multiply result by the unit load ω to obtain deflection.

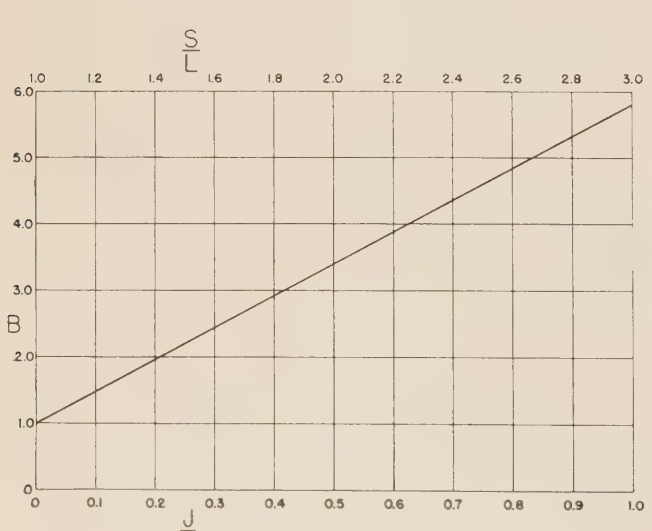

Fig. 5

It should be pointed out that the load ω is the vector resultant of all loads acting on the roll including the weight of the roll body per inch of face. The maximum deflection Δ is therefore measured in the direction of this vector resultant.

For materials other than those given on the chart, the deflection can be computed for a steel roll of the same dimensions and the result multiplied by $29 \times 10^6/E$. For rolls of chilled iron and cast iron, where E varies with load, it is necessary to use an average value based on experience.

To convert to the metric system, with Δ in centimeters and ω in kilograms per centimeter, the result is multiplied by $(2.54)^2/0.454$ or 14.2.

For certain types of rolls, the deflection due to the roll weight along is of interest. This is treated in Appendix B.

DETERMINATION OF CROWN FROM CALCULATED DEFLECTION

For the usual case of two rolls located in a vertical arrangement, where a uniform nip pressure is desired, the crown on the roll diameter is equal to two times the calculated deflection. For rolls in a horizontal arrangement where the roll weights are approximately equal or are small in proportion to the nip pressure, the weights may be neglected. The crown will then be two times the deflection due to the nip pressure, as for rolls arranged vertically.

For the case of offset rolls, or where there is an appreciable deflection component not parallel to the plane of the roll axes, special crown computations must be made. These have been developed by previous authors (*1*, *6*).

It is also important that the shape of the crown curve be considered when grinding rolls, but this subject is beyond the scope of this paper.

OTHER FACTORS AFFECTING DEFLECTIONS AND CROWNS

There are a number of other factors which have minor effects on roll deflections and crowns and which have been treated in the paper industry literature. These include the additional deflection due to shearing stress (*5*), bending perpendicular to the plane of the roll axes due to driving force (*1*), the operation of rolls under nonuniform loads (*2*, *3*, *4*), and the effect of the weight of the journals (*7*). With the exception of the special case of nonuniform load, these effects are negligible in most cases.

Other special cases which sometimes arise include the design of antideflection rolls where the bearing supports are located inside of the roll, and the design of rolls of nonuniform roll body cross section (*7*). No references have been found in the literature in regard to the design computations to be used for the so-called antideflection or crownless rolls, and it is suggested that this would be an interesting topic for a future technical paper.

NOMOGRAPHIC CHART

In order to carry the graphic representation of roll deflections further, a nomograph or alignment chart

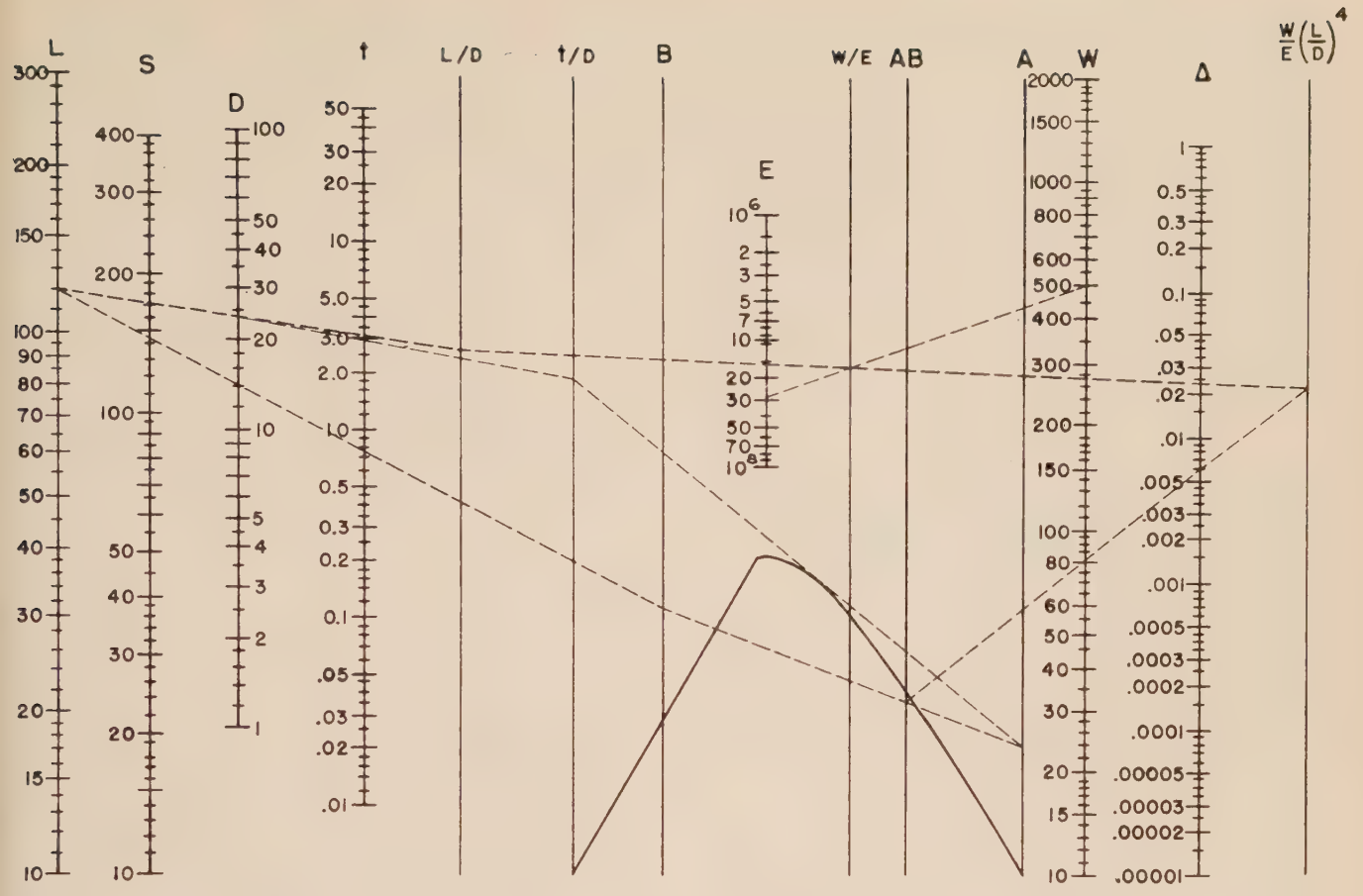

Fig. 6

has been prepared. This is shown in reduced scale in Fig. 6.

All of the significant variables are included here in a single graph, so that slide rule and numercial computations needed with the other graphs are eliminated.

A parallel line nomograph with logarithmic scales was selected in preference to other types, in order to include the wide range of roll sizes and loads encountered in the industry. Since the variables d and J can equal zero, it was necessary to use t and S in their stead for log plotting. The equation therefore becomes:

$$\Delta = \frac{5\omega AB}{6\pi E}\left(\frac{L}{D}\right)^4 = \frac{5\omega}{6\pi E}\left(\frac{L}{D}\right)^4 \frac{\left(2.4\,\frac{S}{L} - 1.4\right)}{\left[1 - \left(1 - \frac{2t}{D}\right)^4\right]}$$

Because D appears twice, and in a complex expression in factor A, it was necessary to use one empirical curve in the nomograph in order to relate t/D to A. This made it possible to include all variables on a single nomograph without repetition or separate charts.

The procedure for using the chart may be described as follows:

Connect L and D to reference line marked L/D
Connect W and E to reference line marked W/E
Connect reference lines L/D and W/E to reference line W/E $(L/D)^4$
Connect L and S to reference line B
Connect D and t to reference line t/D
Draw tangent to curve from t/D to reference line A
Connect A and B to reference line AB
Connect AB and W/E $(L/D)^4$ to give deflection Δ.

The dotted lines show a typical example, for a steel roll of 24 in. diameter by 120-in. face, with a wall thickness of 3 in. and over-all bearing center line of 144 in., under a load of 500 lb. per in. The resulting deflection is shown to be 0.006 in., which checks 0.0062 obtained from the graphs and 0.00618 determined by calculation.

If the connecting lines extend beyond the ends of the reference lines at any point, it indicates that the deflection will be out of the range of the Δ scale. It also indicates in most cases that the dimensions selected are not practical in relation to the load.

Although the accuracy is somewhat less than that obtained with Figs. 2, 4, 5, the nomograph nevertheless appears to be a convenient time-saving device. It is particularly useful in comparing rolls of different dimensions, and in determining the best combination of diameter and wall thickness to meet a given maximum deflection requirement.

CONCLUSION

In conclusion it is believed that the foregoing method and charts should be of assistance to engineers in paper mills, converting plants, and machine building companies. Their use should result in a considerable saving of time in determining roll deflections and crowns, and should make it easier to select roll diameters and

wall thicknesses when designing new machines. In most cases the accuracy of these graphs should be adequate without resort to long numerical computations.

In cases where a high degree of accuracy is deemed necessary, and where the modulus of elasticity is known with sufficient accuracy to warrent more accurate calculations, it is then recommended that the value be calculated numerically. In this case, however, the use of the combined equations developed in this paper will still save time. Thus the fourth power calculations using the ratios L/D and d/D will be considerably simpler than taking the fourth powers of each number individually.

NOMENCLATURE

- Δ = maximum deflection of loaded face at center of roll, inches, in direction of resultant load
- E = modulus of elasticity, pounds per square inch
- I = moment of inertia of cross section (inches)^4
- D = outside diameter of roll, inches
- d = inside diameter of roll, inches
- L = length of uniformly loaded roll face, inches
- J = length of roll journal (distance from edge of loaded roll face to center of self-aligning bearing support), inches
- S = over-all distance between bearing supports, inches, $= L + 2J$
- ω = resultant uniform load on roll face, pounds per inch (vector resultant of roll weight and all external loads)
- t = wall thickness of roll, inches, $= (D - d)/2$

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The authors acknowledge with thanks the comments and assistance rendered by J. B. Gough of Clearwater Beach, Fla. (formerly of the Mead Corp.) and F. A. Garrett of the Canadian International Paper Co., Three Rivers, Que., during the preparation of this paper.

APPENDIX A

Refer to Fig. 4:

Let

- I_J = moment of inertia of journal
- I_L = moment of inertia of roll body
- $V = \frac{I_L}{I_J}$, then $I_J = \frac{I_L}{V}$

Refer to moment diagram on Fig. 7:

$$M_J = \frac{wL}{2} \times J = \frac{wLJ}{2}$$

$$M_c = \frac{wL}{2}\left(J + \frac{L}{2}\right) - \frac{w(L/2)^2}{2} = \frac{wLJ}{2} + \frac{wL^2}{8}$$

Refer to M/EI diagram on Fig. 7:

Using the conjugate beam method and letting Q_1, Q_2 and Q_3 equal the areas as shown we have:

$$Q_1 = \frac{M_J}{EI} \times \frac{L}{2} = \frac{1}{EI}\left(\frac{wL^2J}{4}\right)$$

$$Q_2 = \frac{1}{2} \times \frac{VM_J}{EI} \times J = \frac{1}{EI}\left(\frac{VwLJ^2}{4}\right)$$

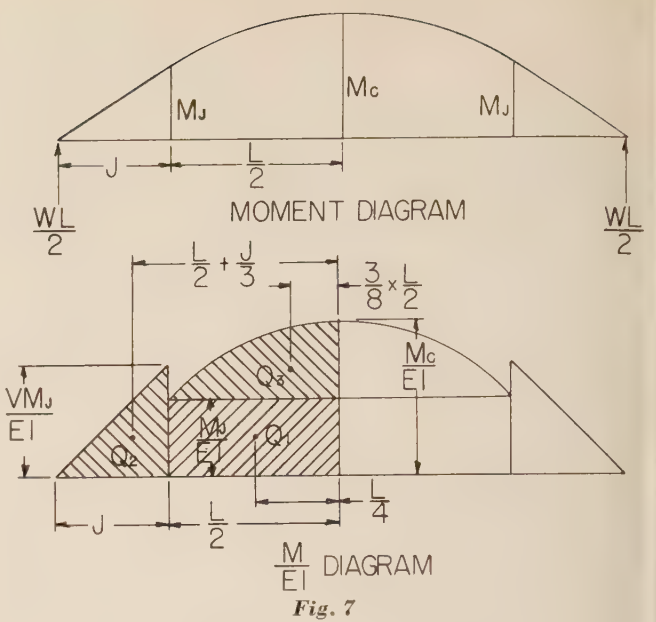


Fig. 7

$$Q_3 = \frac{2}{3} \times \left(\frac{M_c}{EI} - \frac{M_J}{EI}\right)\frac{L}{2} = \frac{1}{EI}\left(\frac{wL^3}{24}\right)$$

Let

- Δ_J = deflection at distance J from bearing
- Δ_c = total deflection of roll body and journals at center of roll

Then $\Delta = \Delta_c - \Delta_J$

$$\Delta_C = \frac{1}{EI}\left[(Q_1 + Q_2 + Q_3)\left(\frac{L}{2} + J\right) - Q_1 \times \frac{L}{4} - Q_2\left(\frac{L}{2} + \frac{J}{3}\right) - Q_3\left(\frac{3}{8} \times \frac{L}{2}\right)\right]$$

$$= \frac{1}{EI}\left[\left(\frac{wJL^2}{4} + \frac{VwLJ^2}{4} + \frac{wL^3}{24}\right)\left(\frac{L}{2} + J\right) - \left(\frac{wJL^2}{4}\right)\frac{L}{4} - \left(\frac{VwLJ^2}{4}\right)\left(\frac{L}{2} + \frac{J}{3}\right) - \left(\frac{wL^3}{24}\right)\left(\frac{3}{8} \times \frac{L}{2}\right)\right]$$

$$\Delta_J = \frac{1}{EI}\left[(Q_1 + Q_2 + Q_3)J - Q_2 \times \frac{J}{3}\right]$$

$$= \frac{1}{EI}\left[\left(\frac{wJL^2}{4} + \frac{VwLJ^2}{4} + \frac{wL^3}{24}\right)J - \left(\frac{VwLJ^2}{4}\right)\frac{J}{3}\right]$$

Combining and subtracting the above equations:

$$\Delta_C - \Delta_J = \frac{wL^3}{16EI}\left(J + \frac{5L}{24}\right)$$

$$\Delta = \Delta_C - \Delta_J = \frac{5wL^4}{384EI}\left(1 + \frac{24J}{5L}\right)$$

APPENDIX B

Deflection of roll due to weight alone:

- ρ = density of roll body material, pounds per cubic inch
- $\omega = \frac{\pi}{4}(D^2 - d^2)\rho$

$$\Delta = \frac{5}{6\pi E} \times \frac{\frac{\pi}{4}(D^2 - d^2)\rho L^4 B}{(D^4 - d^4)}$$

$$\Delta = \frac{5\rho B}{24E}\left(\frac{L^4}{D^2 + d^2}\right)$$

Thus the deflection of a roll due to its weight alone is a function of the fourth power of the length divided by the sum of the squares of the inside and outside diameters. Unfortunately, this equation, either in this form or in other algebraic rearrangements, cannot be expressed conveniently in graphical form.

It is interesting to note, however, that the maximum deflection occurs for a solid roll where $d = 0$, and that Δ

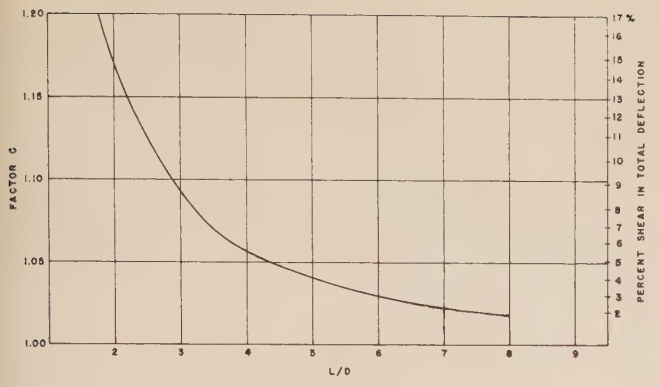


Fig. 8

decreases as d increases. As the wall thickness approaches zero, the value of Δ approaches one half the value for a solid roll.

DISCUSSION

Virgil Spencer and R. E. Wood (Armstrong Cork Co.): Anyone who has figured the deflection of rolls to attain the best relationship of face length to diameter realizes the tediousness of the computations. The graphical determination method presented in this paper not only simplifies the computations but decreases the possibilities for mathematical errors which we humans make. We sincerely congratulate the authors on their approach to simplification.

Our experiences have, to a large extent, been with linoleum calenders where the length to diameter ratio is usually 3.16 or less, and loads range up to 5 tons per in. of face length. We would expect that the usual paper industry roll problem, on the other hand, involves greater length to diameter ratios, and therefore our comments will be directed more toward adapting this graphic determination to our problems.

Our calculations heretofore have usually been confined to the area-of-moments method of bending moment deflection. This graphic determination simplifies the calculations to the point where the beam formula is definitely to be preferred and the answers check closely.

Under the authors' heading, "Other Factors Affecting Deflections and Crowns," it is stated that the factor of additional deflection due to shearing stress is "negligible in most cases." The deflection due to horizontal shear is between 8 and 20% on our particular applications where an error of 5% in the amount of crown is about the borderline between satisfactory operation and removing the rolls for regrinding. We find that adding together the calculated deflections due to bending moment with horizontal shear corresponds with the actual deflections of our rolls. This can be proved by the fact that rolls ground to calculated crowns based on the measured screw loads will calender a flat sheet of linoleum. Therefore, it is necessary for our use, to include the deflection due to horizontal shear.

We use the shear formula as presented in the Hool and Kinne second edition entitled "Structural Members and Connections" (page 88) as follows:

$$y = \frac{NM}{E_s}$$

where N for a circular section is $10/9A$ and therefore

$$y = \frac{10M}{9AE_s}$$

y = deflection of the axis of the roll, measured in inches in the direction of the resultant load, at the center or other point as compared to the axis of the roll at the left edge of the loaded roll face
M = area of the shear diagram measured in inch pounds between the center or other point and the left edge of the loaded face
A = cross section area of the roll measured in square inches

This formula for deflection—due to horizontal shear for solid or hollow rolls—can be arranged as follows:

$$y = \frac{10\,\frac{(wL/2)}{2}\,\frac{L}{2}}{9AE_s}$$

where

w = load per inch of roll face length
L = loaded roll face length
E_s for steel = 40% of E = 11,600,000

The rearranged formula for solid or hollow steel rolls is

$$y = 0.00000001197\,\frac{wL^2}{A}$$

The rearranged formula for solid steel rolls only is

$$y = 0.00000001524\left(\frac{L}{D}\right)^2 w$$

It will be observed that this deflection due to shear for a solid roll is a function of the ratio (L/D) and therefore lends itself to graphic determination in a manner similar to the simplified determination for bending moment deflection developed so ably by the authors.

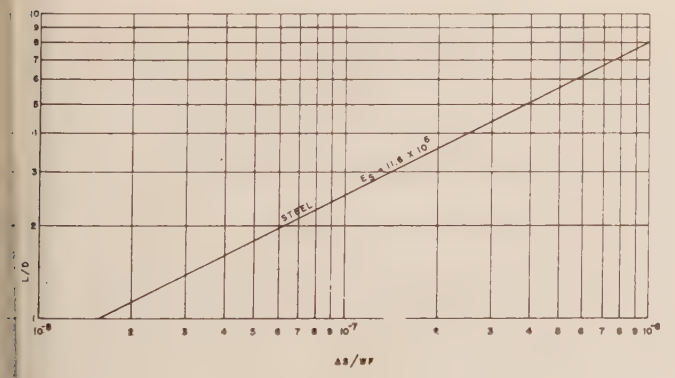


Fig. 9

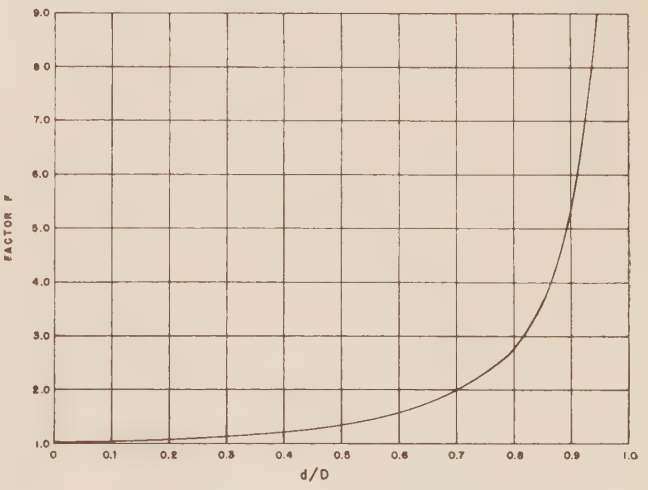


Fig. 10

Attached is a graph (Fig. 8) plotted to show first, what percentage the deflection due to shear is as compared to the total deflection of bending moment and shear combined; and second, a new factor C for any L/D ratio which can be multiplied by the deflection due to bending moment indicated by the authors' charts to give the total deflection as follows:

$$\text{Total deflection of solid rolls} = \Delta \cdot \text{factor } B \cdot \text{factor } C$$

For hollow rolls, this factor C must be increased in inverse proportion to the reduction in cross-section area. In this case, for hollow rolls, the authors' A must, of course, also be included.

How much value this additional factor C will have in solving crown problems in the paper industry is something we do not know. We will say, however, that the graphic determination method proposed by the authors, and our addition of the use of factor C herein described will be of help to us.

AUTHORS' COMMENT: The discussion of the deflection due to shear by Messrs. Spencer and Wood is a most interesting and significant addition to this subject. From their analysis it is apparent that this added deflection is appreciable for rolls of low L/D ratio under heavy load. Although this condition is seldom encountered in the paper industry, it will be found frequently in calenders for floor coverings, rubber, and plastics, and in metal rolling mills.

The equations and graph which Messrs. Wood and Spencer have developed give the added deflection due to shear accurately for steel rolls where A and B are near unity (solid or nearly solid rolls with short journals). Presumably rolls under such heavy loads would be constructed in this manner.

We have thought, however, that it might be interesting to develop this further to give a general equation for all cases. In the following equations, the same nomenclature is used as in the foregoing paper with the subscript s denoting shear.

$$\Delta_s = \frac{10wL^2/8}{9E_s(D^2 - d^2)\pi/4} = \frac{5\omega}{9\pi E_s}\left(\frac{L}{D}\right)^2\left(\frac{1}{1 - d^2/D^2}\right)$$

Let factor $F = \dfrac{1}{1 - d^2/D^2}$

$$\frac{\Delta s}{\omega} = \frac{0.177F}{Es}\left(\frac{L}{D}\right)^2$$

These equations are in the same form, as those for deflection due to bending moment, and are plotted in Figs. 9 and 10.

To determine the deflection due to shear, L/D and d/D are determined, and the values of Δ_s/ω and F are taken from the graphs. The value of Δ_s/ω is then multiplied by F and by the unit load ω to obtain the total Δ_s.

This is then added to the deflection due to bending moment to obtain the total deflection of the roll.

Presumably the curve of the crown for shear is not the same as that for bending, and this should be taken into account when crowning rolls where deflection due to shear is a major factor.

Studies on Modified Cellulose

IV. Oxidation by Chlorous Acid and Reduction by Sodium Borohydride of Chemically Modified Celluloses

ALEXANDER MELLER

The hot alkali sensitivity of both hydrolyzed, periodate and dichromate-oxidized cotton cellulose, and of oxidized (bleached) wood pulps decreases considerably upon chlorous acid oxidation or sodium borohydride reduction in alkaline solution. Reduction of "gluconic oxycellulose" (*1*) by acidic solutions of sodium borohydride decreases its resistance toward hot, dilute alkali. Reductions with acidic solutions of sodium borohydride of chlorite-periodate and chlorite-dichromate oxycelluloses do not change significantly their hot alkali stability. The carbonyl group content of oxidized cotton cellulose and wood pulps decreases as a result both of chlorous acid oxidation and of alkaline sodium borohydride reduction. The uronic acid carboxyl content of dichromate oxycellulose increases considerably on chlorous acid oxidation, indicating the presence of aldehyde groupings on carbon six of some of the glucose residues in this oxycellulose. The hot alkali stability of modified cellulose fibers is greatly influenced by the enolizability of chemically modified functional groups present in the glucose anhydride building units. The very high resistance to alkali of "cellulitol" (*2*) and of methanolized cellulose (*3*) would be consistent with the nonenolizability of both the hydroxyl (anhydride) and glucosidic methoxyl end groups present in these modified celluloses. Gluconic oxycellulose seems to contain lactonized carboxyl end groups, reducible with acidic sodium borohydride solution. The carboxyl groups in chlorite-periodate and chlorite-dichromate oxycelluloses do not appear to be lactonized, and are not easily reducible with sodium borohydride. "Potential degradation" of cellulose fibers, which manifests itself in subsequent alkaline treatment, can be remedied to a large extent by chlorous acid oxidation or by sodium borohydride reduction in alkaline solution.

ALEXANDER MELLER, Research Laboratory, Australian Paper Manufacturers Ltd., Melbourne, Australia.

Two recent short communications described the changes in the hot alkali stability of chemically modified cellulose fibers brought about by sodium borohydride reduction (*2*, *4*). It was found that the resistance of acid degraded cotton fibers (hydrocellulose) towards boiling 1% NaOH solution increased considerably after treating them with mildly alkaline solutions of sodium borohydride at room temperature (*2*). Similarly, the hot alkali sensitivity of both periodate and dichromate oxycelluloses decreased to low levels upon reduction by alkaline sodium borohydride solutions (*4*). The observed increased resistance toward hot weak alkali of sodium borohydride

reduced hydrocelluloses (*2*) was confirmed in subsequent work by others (*5*).

The increased stability to hot weak alkali resulting from the action of sodium borohydride on hydrocellulose and oxidized cellulose was expected, because previous work had shown that a conversion of carbonyl groups to carboxyls in chemically modified celluloses rendered them stable to hot weak alkali solution (*1*). Hence, a conversion of carbonyls to hydroxyls was expected to have a similar effect. Sodium borohydride in alkaline solution reduces aldose sugars to sugar alcohols (*6*, *7*). It was also expected that a conversion of lactonized carboxyl groups to carbonyls in oxycelluloses would decrease their resistance to hot weak alkali solutions (*2*). Sodium borohydride in acid solution reduces sugar acid lactones to sugars (*6*, *7*).

The present paper describes the relevant work in more detail and its extension to chemically modified wood pulps. The object of the work, thus, may be formulated as follows: (1) to apply chlorous acid and sodium borohydride as selective oxidizing and reducing agents, respectively, to both acid hydrolyzed and differently oxidized cotton celluloses and wood pulps and (2) to determine (a) the hot alkali stability, (b) the carbonyl and carboxyl contents of the modified celluloses, and (c) to contribute to the disclosure of the chemical constitution of both gluconic and dichromate oxycelluloses (*1*, *8*).

EXPERIMENTAL

The materials used for making chemically modified celluloses were: (1) cotton fibers; kier-boiled, commercial product; (2) paper-grade bleached eucalyptus kraft pulp; product of Australian Paper Manufacturers Ltd.; (3) dissolving grade eucalyptus wood cellulose prepared according to a process described previously (*9*); and (4) dissolving grade softwood sulphite pulp; commercial product made in Sweden.

The celluloses and wood pulps chemically modified by acid hydrolysis and oxidation (bleaching) were prepared according to essentially the same methods as described in previous reports (*1*, *8*). The details of conditions used for making these chemically modified cotton celluloses and wood pulps are listed in Table I.

In order to prepare modified cellulose samples free from ash, in particular when potassium dichromate was used as the oxidant, they were first washed with distilled water followed by two soakings in approximately 0.5 *N* $(CO_2H)_2$ solution and finally washed with distilled water.

The chemical reductions with sodium borohydride solutions at pH 4 and at pH 8 were performed as follows: to an aqueous slurry of modified cellulose there were added simultaneously a hydrochloric acid and a sodium borohydride solution with stirring. After completing the reduction at pH 8 the reaction mixture was acidified to decompose residual borohydride, and the reduced cellulose sample was washed with distilled water. In the chemical reductions at pH 9.5, sodium borate solution was added to the cellulose and then an aqueous solution of sodium borohydride. The reaction mixture was stirred until practically all the sodium borohydride added was consumed. After the reduction was completed, the procedure was as for the reduction at pH 8.

In some experiments the reduction was repeated after the quantity of sodium borohydride added was consumed in the first reduction.

In all the experiments with the wood pulps both oxidized and reduced samples were first washed with distilled water, then soaked overnight in approximately 0.1% HCl solution, washed again, and soaked in 0.5 *N* $(CO_2H)_2$ solution, and finally washed with distilled water.

All preparations were dried and stored at 68°F. and 65% R.H.

A number of yield-determinations have also been done in order to see whether during oxidation and reduction a substantial solubilization of the celluloses took place.

The designation of the samples and the methods used for their preparation are listed in Table I.

The "hot alkali stability," carbonyl, and total and uronic carboxyl contents of the cellulose samples were estimated by methods used in previous work (*1*, *8*, *10*, *11*).

RESULTS

The results are listed in Tables I and II, and certain relationships are shown in Fig. 1.

DISCUSSION

The Effect of Alkaline Solutions of Sodium Borohydride and of Chlorous Acid at pH 2.5

In agreement with the results of previous investigations (*2*) chemical reduction by alkaline solutions of sodium borohydride rendered hydrocelluloses more stable to boiling 1% NaOH solution. Similarly, the hot alkali sensitivity of periodate and dichromate oxycelluloses decreased to low levels upon reduction with alkaline solutions of sodium borohydride.

Yields varying from 99 to 100% show that no substantial solubilizing took place during the chemical reduction, i.e., during the preparation of the reduced celluloses. The increased resistance to the hot alkali solution can therefore be ascribed to a conversion of reducible carbonyl groups to hydroxyls in acid hydrolyzed cellulose, and periodate and dichromate oxycelluloses.

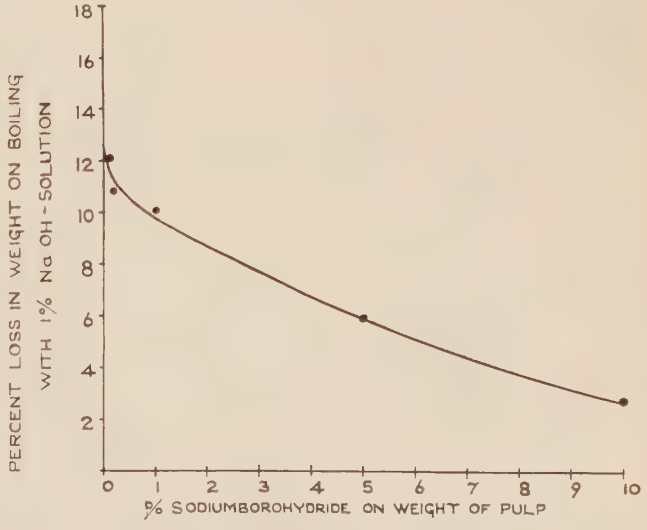


Fig. 1. The effect of sodium borohydride on hot alkali stability of postbleached wood pulp

These results demonstrate the dominant effect of carbonyl groups of chemically modified celluloses on their hot alkali stability and are in good agreement with the conclusions drawn in previous work.

The results obtained by chlorous acid oxidation of hydrocelluloses and of periodate and dichromate oxycelluloses also confirm those of previous investigations (*1*, *8*). Chlorous acid oxidation has rendered

Table I. Showing the Conditions Used in Preparing the Modified Cotton Celluloses and Wood Pulps, and Their Hot Alkali Stabilities

Serial no. of product	*Designation of product*	*Starting material*	*Reagent*	*Temp., °C.*	*Period, hr.*	*pH*	*Cellulose conc.*[a]	*Hot alkali stability*[b]
1	Cotton Fibers							1.2
2	Hydrocellulose VI	1	0.5 *N* HCl	100	6	...	1:15	42.8
3	Gluconic oxycellulose VI (S)	2	0.4 *M* $HClO_2$	20–25	5	2.5	1:15	17.1
4	Methanolized 3	3	Methanol with 2% HCl	20	336	...	1:30	9.4
5	Acid reduced 4	4	10% $NaBH_4$	20–25	1/3	4	1:40	12.9
6	Hydrocellulose VII	1	0.5 *N* HCl	100	3 1/2	...	1:15	41.3
7	Cellulitol VII (S)	6	10% $NaBH_4$	20–25	2/3	8	1:40	29.0
8	Cellulitol VII (D)	6	2 × 10% $NaBH_4$	20–25	2 × 2/3	8	1:40	20.8
9	Cellulitol VII (high pH)	6	10% $NaBH_4$	20–25	5	9.6	1:40	4.5
10	Gluconic oxycellulose VII (S)	6	0.4 *M* $HClO_2$	20–25	5	2.5	1:30	17.0
11	Gluconic oxycellulose VII (D)	6	2 × 0.4 *M* $HClO_2$	20–25	2 × 5	2.5	1:30	11.8
12	Gluconic oxycellulose VII (T)	6	3 × 0.4 *M* $HClO_2$	20–25	3 × 5	2.5	1:30	7.5
13	Acid reduced (S) 12	12	10% $NaBH_4$	20–25	1/3	4	1:40	12.7
14	Acid reduced (D) 12	12	2 × 10% $NaBH_4$	20–25	2 × 1/3	4	1:40	15.0
15	Neutral reduced (D) 12	12	2 × 10% $NaBH_4$	20–25	2 × 1/3	6–7	1:40	13.7
16	Rechlorited 14	14	0.4 *M* $HClO_2$	20–25	5	2.5	1:30	7.5
17	Acid reduced 6	6	10% $NaBH_4$	20–25	1/3	4	1:40	41.4
18	Periodate oxycellulose V	1	0.25 *M* HIO_4	20	236	4.5	1:25	40.2
19	Alkaline reduced 18	18	10% $NaBH_4$	20–25	2/3	8	1:40	7.6
20	Chlorited 18	18	0.4 *M* $HClO_2$	20–25	5	2.5	1:30	10.0
21	Acid reduced 20	20	5 × 10% $NaBH_4$	20–25	5 × 1/3	3–4	1:40	12.6
22	Dichromate oxycellulose	1	0.2 *N* $H_2C_2O_4$ and 0.4 *N* $K_2Cr_2O_7$[c]	20	2 × 17	...	1:30	41.0
23	Chlorited (S) 22	22	0.4 *M* $HClO_2$	20–25	5	2.5	1:30	17.8
24	Chlorited (D) 22	22	2 × 0.4 *M* $HClO_2$	20–25	2 × 5	2.5	1:30	14.9
25	Chlorited (T) 22	22	3 × 0.4 *M* $HClO_2$	20–25	3 × 5	2.5	1:30	14.8
26	Acid reduced (D) 22	22	2 × 10% $NaBH_4$	20–25	2 × 1/3	3–4	1:40	39.7
27	Alkaline reduced (D) 22	22	2 × 10% $NaBH_4$	20–25	2 × 2/3	8	1:40	12.5
28	Alkaline reduced (D High pH) 22	22	2 × 10% $NaBH_4$	20–25	2 × 5	9–9.5	1:40	6.3
29	Chlorited 28	28	0.4 *M* $HClO_2$	20–25	5	2.5	1:30	6.0
30	Alkaline reduced (D) 25	25	2 × 10% $NaBH_4$	20–25	2 × 2/3	8	1:40	12.1
31	Acid reduced (D) 25	25	2 × 10% $NaBH_4$	20–25	2 × 1/3	4	1:40	16.7
32	Rechlorited 31	31	0.4 *M* $HClO_2$	20–25	5	2.5	1:30	13.6
33	Methanolized 24	24	Methanol with 2% HCl	20	336	...	1:30	13.8
34	Acid reduced 33	33	3 × 10% $NaBH_4$	20–25	3 × 1/3	3–4	1:40	15.4
35	Bleached paper grade eucalyptus kraft pulp						[d]	
36	Control	35	Dilute acetic acid	20	116	4.6	2.5	20.3
37	Periodate oxidized 35	35	0.022 *M* HIO_4	20	116	4.6	2.5	36.5
38	Chlorited 37	37	0.4 *M* $HClO_2$	20–25	5	2.5	3	11.2
39	Alkaline reduced 37	37	10% $NaBH_4$	20–25	2/3	8	2.5	12.3
40	Dichromate oxidized 35	35	0.2 *N* $H_2C_2O_4$ and 0.4 *N* $K_2Cr_2O_7$[c]	20	17	...	3	43.8
41	Chlorited 40	40	0.4 *M* $HClO_2$	20–25	5	2.5	3	19.8
42	Alkaline reduced (D) 40	40	2 × 10% $NaBH_4$	20–25	2 × 2/3	8	3	10.7
43	Alkaline reduced (high pH) 40	40	10% $NaBH_4$	20–25	5	9–9.5	3	...
43A	Alkaline reduced (D) 41	41	2 × 10% $NaBH_4$	20–25	2 × 2/3	8	3	...
44	Dissolving Grade Eucalyptus Pulp							
45	Control	44	Acid wash only					4.4
46	Chlorited 44	44	0.4 *M* $HClO_2$	20–25	5	2.5	6	2.4
47	Alkaline reduced (0.2) 44	44	0.2% $NaBH_4$	20–25	5	9.5	3	2.5
48	Alkaline reduced (5) 44	44	5% $NaBH_4$	20–25	5	9.5	3	1.5
49	Post bleached 44	44	0.75% Cl	32–33	5	...	10	14.0
50	Chlorited 49	49	0.4 *M* $HClO_2$	20–25	5	2.5	6	7.5
51	Alkaline reduced 49	49	5% $NaBH_4$	20–25	5	9.5	3	2.9
52	Dissolving Grade Softwood Sulphite Pulp							
53	Control	52	Acid wash only					6.3
54	Chlorited 52	52	0.4 *M* $HClO_2$	20–25	5	2.5	5	5.2
55	Alkaline reduced 52	52	10% $NaBH_4$	20–25	5	9.5	3	3.2
56	Acid hydrolyzed 52	52	1.4 *N* HCl	50–55	4 1/2	...	10	15.2
57	Chlorited 56	56	0.4 *M* $HClO_2$	20–25	5	2.5	6	8.0
58	Alkaline reduced 56	56	1% $NaBH_4$	20–25	5 1/2	9.5	3	14.4
59	Post bleached 52	52	0.75% Cl	30–35	4	...	10	17.8
60	Chlorited 59	59	0.4 *M* $HClO_2$	20–25	5	2.5	5	7.0
61	Alkaline reduced (0.1) 59	59	0.1% $NaBH_4$	20–25	5	9.5	3	12.1
62	Alkaline reduced (0.2) 59	59	0.2% $NaBH_4$	20–25	5	9.5	3	10.8
63	Alkaline reduced (1) 59	59	1% $NaBH_4$	20–25	5	9.5	3	10.0
64	Alkaline reduced (5) 59	59	5% $NaBH_4$	20–25	5	9.5	3	6.0
65	Alkaline reduced (10) 59	59	10% $NaBH_4$	20–25	5	9.5	3	2.8

[a] Ratio of cellulose to reagent solution.
[b] Per cent loss in weight on boiling with 1% NaOH solution for 2.5 hr.
[c] Ratio of reagents by volume = 3:1.
[d] Pulp stock concentration (%).
(S), (D), and (T) refer to single, double, and triple treatments, respectively.
% $NaBH_4$ refers to the weight of $NaBH_4$ per 100 g. of cellulose.
% Cl refers to the weight of active chlorine per 100 g. of pulp (calcium hypochlorite bleaching powder).

these modified celluloses more resistant toward hot 1% NaOH solution.

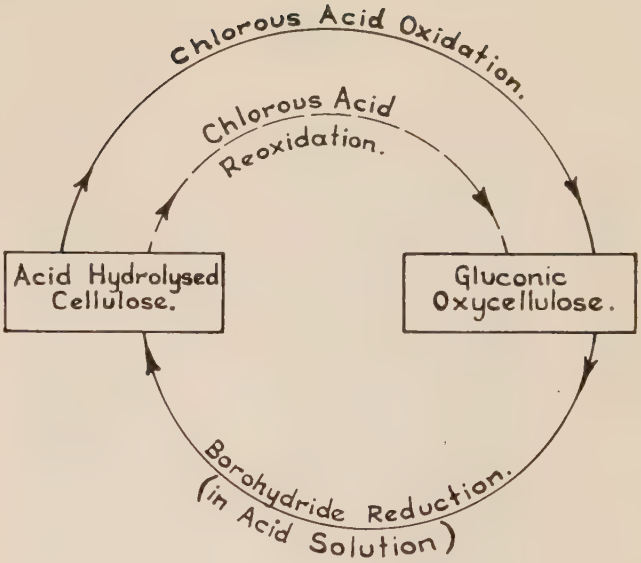
The results of carbonyl and carboxyl determinations show that alkaline sodium borohydride reduces and chlorous acid oxidizes carbonyl groups present in chemically modified celluloses. That the reduction with alkaline borohydride leads to hydroxyls is borne out by the result of reoxidation with chlorous acid of the alkaline borohydride reduced dichromate oxycellulose. Since this reagent does not oxidize hydroxyl groups, the reoxidized sample (serial no. 29) showed practically the same hot alkali stability, and carbonyl and carboxyl group contents as the reduced sample, i.e., sample before reoxidation (serial no. 28).

On reducing acid-hydrolyzed, periodate and dichromate oxidized and post-bleached wood pulps with alkaline sodium borohydride solutions their resistance to hot alkali solution increased considerably.

In one series of experiments, the percentage of sodium borohydride on the weight of a post-bleached sulphite dissolving grade wood pulp has been varied and its effect on hot alkali stability is shown by the curve in Fig. 1. It appears that as little as 0.1% sodium borohydride on the weight of pulp used brings about a substantial stabilization. Further experiments would be needed in order to establish whether such a relatively small quantity of this reducing agent would result in a similar stabilization with other types of bleached pulps. The results with acid hydrolyzed-cotton and wood pulp indicate that larger quantities of sodium borohydride are needed for a significant stabilization of acid hydrolyzed cellulose fibers. It appears that the low accessibility of acid hydrolyzed cellulose fibers slows down the chemical reduction and hydrogen is wasted by the self-decomposition of the reagent. Both factors would influence the quantity of borohydride needed for an efficient reduction. It also appears that reduction with sodium borohydride at pH 9.5 is more effective than at pH 8. However, the influence of the quantity of borohydride and of pH in reducing chemically modified celluloses was outside the scope of the present investigation.

The Effect of Acid Solutions of Sodium Borohydride and the Chemical Constitution of Gluconic and Dichromate Oxycelluloses

On applying acid solutions of sodium borohydride to gluconic oxycellulose, its resistance toward hot alkali was decreased. This observation would be consistent with the conversion of lactonized carboxyl end groups of the gluconic oxycellulose to aldehydes (hemiacetals). This means that, starting with hydrocellulose of low hot alkali resistance, chlorous acid oxidation yields gluconic oxycellulose (alkali resistant) which on reduction with an acidified solution of sodium borohydride is converted back to hydrocellulose of low alkali resistance. Reoxidation of the acid-reduced gluconic oxycellulose by chlorous acid resulted again in a stable gluconic oxycellulose. These observations may be shown by the scheme below.



While the evidence of decreased alkali resistance of the gluconic oxycellulose resulting from reduction by an acidic sodium borohydride solution suggests that this oxycellulose contains lactonized carboxyl groups, chlorite-periodate and dichromate oxycelluloses seem to contain mainly free carboxylic groups not readily reducible by acidic borohydride solutions. Repeated treatments of chlorite-periodate and chlorite-dichromate oxycelluloses with acid solutions of sodium borohydride had only a comparatively small effect on hot alkali stability. The relevant carbonyl and carboxyl group contents corroborate these results.

The results of decarboxylation experiments (uronic acid carboxyl contents listed in Table II) also show that the uronic acid carboxyl content of the dichromate and chlorite-dichromate oxycelluloses has been changed very little by treatment with acid solutions of sodium borohydride.

It seems that dichromate and chlorite-dichromate oxycelluloses contain only a small amount of lactonized carboxyl groups.

Attempts to esterify the carboxyl groups in chlorite-periodate and chlorite-dichromate oxycelluloses, with the object of subsequently reducing the esterified carboxyl groups to carbonyls by acidic solutions of sodium borohydride, have not yet been successful. The esterifications were performed at room temperature with methanolic hydrochloric acid. On applying the same esterifying solution at boiling temperature the derived preparations were so much depolymerized that they yielded milky and unfilterable residues in the hot alkali stability test.

In agreement with previous observations (*10*, *11*) the uronic acid carboxyl content of the chlorite-dichromate oxycelluloses is much higher than that of the parent dichromate oxycellulose. These results suggest that dichromate oxycellulose contains 6 aldehydo glucose anhydride building units which are readily oxidized to glucuronic units by chlorous acid. Chlorous acid is a specific oxidant for the conversion of aldoses to aldonic lactones (*12*).

"The characteristic rate constants of decarboxylation" of dichromate and chlorite-dichromate oxycelluloses are very close to that of glucuronolactone (Table II). These rate constants have been computed by means of rate equations discussed recently (*10*, *11*). The good agreement of these constants can be regarded as evidence which shows the presence of glucuronic structural units in these oxidized celluloses.

Dichromate oxycellulose appears also to contain

Table II. Showing Total and Uronic Acid Carboxyl and Total Carbonyl Contents and Characteristic Rate Constants of Decarboxylation of Modified Cotton Celluloses and Wood Pulps

Serial No. of product[a]	*Designation of product*[a]	*Apparent total carbonyl, moles/g. × 10⁴*	*Apparent total carboxyl, moles/g. × 10⁴*	*Uronic acid carboxyl, moles/g. × 10⁴*	*Strength of H_2SO_4 used in decarboxylation, % W/W*	*Characteristic rate constant of decarboxylation*[b]
6	Hydrocellulose VII	0.86	0.090	...	..	...
9	Cellulitol VII	0.47	0.070	...	..	...
11	Gluconic oxycellulose VII (D)	0.50	0.335	...	..	...
22	Dichromate oxycellulose	3.05	1.31	1.24	27	0.405
24	Chlorite (D) 22	1.10	3.03	...	..	...
25	Chlorite (T) 22	1.05	3.30	2.65	24	0.28
27	Alkaline reduced 22	0.88	1.13	1.14	24	0.28
28	Alkaline reduced (D high pH) 22	0.58	1.11	...	..	...
29	Chlorited 28	0.55	1.10	...	..	...
30	Alkaline reduced (D) 25	0.70	3.20	2.8	24	0.27
26	Acid reduced (D) 22	3.10	1.22	...	..	...
31	Acid reduced (D) 25	1.01	3.15	2.45	24	0.28
32	Rechlorited 31	0.88	3.25	...	..	...
18	Periodate oxycellulose V	8.6	0.14	...	..	...
20	Chlorited 18	1.5	7.7	...	..	...
19	Alkaline reduced 18	2.10	0.09	...	..	...
40	Dichromate oxidized 35 (paper pulp)	2.90	1.45	...	..	...
41	Chlorited 40	1.15	3.69	...	..	...
42	Alkaline reduced (D) 40	0.95	1.45	...	..	...
43	Alkaline reduced (high pH) 40	0.76	1.20	...	..	...
43A	Alkaline reduced (D) 41	1.01	3.40	...	..	...
	Glucuronolactone	...	...	...	27	0.40
	Glucuronolactone	...	...	...	24	0.30

[a] See Table I.

[b] The "characteristic rate constant of decarboxylation" (*10, 11*) refers to k_2 in the equation: $x = a\left[1 - \frac{1}{k_2 - k_1}(k_{2e}^{-k_1 t} - k_{1e}^{-k_2 t})\right] + k_0 t$ where x is the amount of carbon dioxide evolved in reaction time t, a the uronic acid carboxyl content in terms of carbon dioxide, k_1 the rate constant of the first step in the decarboxylation mechanism, k_2 that of the second step, and k_0 is the sum of the rates of the side reactions.

some carbonyl groups which are not oxidized or very slowly oxidized by chlorous acid (*1, 8*) and they seem to be slowly reduced by alkaline borohydride. They are probably ketonic carbonyl groups (*1*) either on carbon 2 or 3, or on both, in some of the glucose anhydride building units of the cellulose molecules in this oxycellulose. Keto sugars are not oxidized by chlorous acid (*12*), or possibly oxidized at a very low rate. Chromic acid oxidized starch contains carbonyl groups as 2-keto-glucose residues (*13*). Nitrogen dioxide causes a coincidental oxidation in the cellulose molecules of carbon atoms 6 to carboxyl groups and carbon atoms 2 and 3 to ketonic carbonyl groups (*14*).

The Mechanism of Alkaline Degradation of Chemically Modified Cellulose Fibers

Although this investigation has not been concerned directly with the chemical mechanism involved in the fragmentation and dissolution of modified celluloses by hot weak alkali solutions, it may be appropriate to refer briefly to some contributions made to a better understanding of this problem.

It appears that the hot alkali stability of chemically modified celluloses is governed by the presence of enolizable carbonyl groups. Their presence may lead to molecular configurations which readily hydrolyze with hot aqueous alkali solutions, as discussed in more detail elsewhere (*15*).

If the enolizability of carbonyl groups in chemically modified celluloses is responsible for their fragmentation by alkali solutions, then it may be expected that an aldehydic carbonyl (or hemiacetal) group may impart great alkali sensitivity to modified cellulose, because it enolizes readily. Carboxyl groups, enolizing less readily may impart a greater resistance to chemically modified cellulose. Finally, hydroxyl groups not being able to enolize would impart the greatest alkali resistance to modified cellulose. In addition, a conversion of the hemiacetal end groups in cellulose to glucosidic methoxyl (methanolized cellulose) would increase its resistance to alkali, because the glucosidic methoxyl does not enolize. The results of the present investigation well corroborate the view set out above which is further supported by the results obtained with methanolized hydrocellulose (*3, 1*).

The formulas in Fig. 2 illustrate schematically, and in a simplified manner, this view of the enolizability of the modified functional groups present in oxidized, reduced, and methanolized cellulose and its bearing on alkali stability.

The "Actual" and "Potential" Degradation of Cellulose Fibers

The results of this investigation may have some significance in practical bleaching of wood pulps where the polymeric carbohydrate fractions (cellulose, pentosans, and polyuronides) undergo a chemical modification. In multistage bleaching processes weak alkali

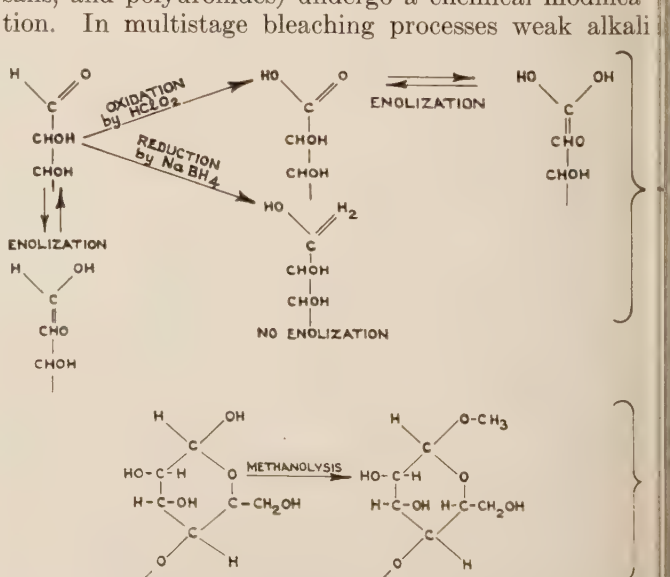


Fig. 2. The enolizability of functional groups in chemically modified celluloses

solutions are used for extracting colored constituents from partially bleached wood pulps. The response of partially bleached wood pulps to hot alkaline extracting solutions largely depends on the chemical modification of the pulp constituents which takes place in the processing stages prior to alkaline extraction (*16*). In these processing stages chlorine solutions are used at different pH values and temperatures. There are two types of degradation which may be distinguished. The bleaching solutions either depolymerize the polymeric carbohydrate fractions or they alter them chemically without shortening the chain molecules. In the first type, acid hydrolysis would lead to a lower average D.P. of the cellulose. This degradation may be considered as an "actual" one. The second type of degradation, where the polymeric carbohydrate fractions are rendered vulnerable to alkaline fragmentation, is not an actual degradation, because it does not result in an immediate shortening of the polymeric carbohydrate fractions. It can be regarded as a "potential" degradation, involving a chemical modification of the cellulose, e.g., an oxidation of some of the functional groups of the glucose anhydride structural building units to carbonyls, making them sensitive to hot weak alkali solutions. While the "actual" degradation is a shortening of the polymeric carbohydrate chains, the "potential" degradation results in a shortening of these chains only during a subsequent treatment with alkali solutions. A reversal of the "actual" degradation has not yet been accomplished; it would involve a repolymerization of fragmented cellulose chain molecules. On the other hand "potentially" degraded cellulose fibers can be cured or remedied either by reoxidation, methanolysis, reduction or by other means. Thus "overbleached" wood pulps containing a relatively large number of aldehydic carbonyl groups are "potentially" degraded and they suffer a great material loss in alkaline extraction. They can be rendered more stable toward alkali solutions by reoxidation with chlorous acid or by reduction with mild alkaline solutions of sodium borohydride.

SUMMARY AND CONCLUSION

1. Cotton and wood pulp celluloses modified by the action of acids and oxidizing agents (periodic acid, potassium dichromate in oxalic acid solution, and alkaline solutions of chlorine) suffer a great loss in weight when boiled with 1% NaOH solution.

2. On treating these modified cellulose fibers with mild alkaline solutions of sodium borohydride at room temperature their resistance to hot alkali solution is considerably increased.

3. Oxidation of these modified celluloses with chlorous acid solution resulted in an increased stability toward boiling alkali solution.

4. Post-bleached wood pulps exhibiting low resistance to hot weak alkali solution were rendered hot alkali stable both by chlorous acid oxidation and by reduction with alkaline solutions of sodium borohydride.

5. On treating gluconic, dichromate, and chlorite-dichromate oxycelluloses with acid solutions of sodium borohydride the alkali resistance of the first decreased considerably while that of the second and third types of oxycellulose decreased only slightly.

6. The carboxyl group content of modified celluloses and wood pulps increased upon chlorous acid oxidation and their carbonyl group content decreased.

7. Reduction of modified celluloses and wood pulps with alkaline borohydride solution resulted in a decreased carbonyl group content.

8. The carboxyl content of dichromate and chlorite-dichromate oxycelluloses decreased only slightly upon treatment with acid solutions of sodium borohydride.

9. The uronic acid carboxyl content of dichromate oxycellulose increased considerably on chlorous acid oxidation.

10. While gluconic oxycellulose seems to contain lactonized carboxyl end groups which are readily reducible by acid borohydride solution, most of the carboxylic groups of dichromate and chlorite dichromate oxycelluloses appear to be of the free, i.e., non-lactonized form.

11. Dichromate oxycellulose contains 6-aldehydo glucose anhydride structural units and chlorous acid converts these units into glucuronic acid anhydride units. The same oxycellulose seems to contain some keto-carbonyl groups which are sluggishly oxidized by chlorous acid, and appear to be somewhat less sluggishly reduced by alkaline borohydride solutions.

12. The fragmentation and dissolution of chemically modified cellulose fibers by boiling 1% NaOH solution is predominantly influenced by the presence of enolizable carbonyl groups. Conversion of these to non-enolizable groupings renders the modified celluloses stable towards hot weak alkali solution.

13. While acid hydrolysis causing a splitting of the polymeric carbohydrate molecules in cellulosic fibers can be regarded as an "actual" degradation, oxidations leading to the formation of carbonyl groups without shortening the polymeric chains, may constitute a "potential" degradation, which manifests itself in subsequent alkaline treatment of the modified fibers.

14. "Actually degraded" (hydrolyzed) cellulose fibers have not been reversed or remedied; "potentially degraded" fibers have been cured or remedied both by chlorous acid oxidation and by sodium borohydride reduction.

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Progress Notes on Machine Coating

B. W. ROWLAND

A brief review of certain aspects of the machine-coating problem such as have become more fully apparent in the 15 years following an earlier review by the author. Under greatly increased coating speeds, higher quality standards, greater diversity in coating types, along with the advent of various modifications in coating equipment, it has been possible to observe certain features of coating variables somewhat more clearly. The persistent need of any useful points of view still may justify an oversimplification at present, as was the case in the past. The present discussion will emphasize the general apparent importance of "water mechanism" originally defined in terms of the "blotter test" and, more recently, "water release." The water release was initially related to clay but has more recently been found to relate not only to clay itself but to the amount of dispersing agent, as does the high shear viscosity behavior. It is suggested that the effect of starch on coating color rheology and its water release become secondary to that of the clay under conditions of high shear. A brief description is presented of the problems and procedures which a Georgia kaolin producer employs to provide the paper mills with large tonnage amounts of suitable and uniform coating clays.

At a time when machine coating was relatively a new art, an attempt was made by the author (*1*) to recognize and define such variables as were then experienced, and to relate coating quality to some of them. Since then, machine coating has become a greatly advanced and a far more critical operation, due to very much higher speeds, together with the continuous need for improved quality. This speed-up has not been without its advantages, however, inasmuch as it has caused certain variables to become magnified and hence more readily perceived; it has also brought new and finer adjustments into coating equipment in order to permit operation or improve quality under such unbalanced conditions of coating color and raw stock as would have been difficult, to say the least, in earlier days.

It may now be useful to review again, some 15 years later, a family of machine-coating variables, in the light of experience to date, and to attempt a correlation of them. For this purpose, the import of much of the experience, technical literature, and patent disclosures must be taken into account and somehow pieced together into an over-all interpretation, if such is possible. A few dominating variables have seemed to present themselves, and will now be briefly outlined. Any generalizations in a system of such complexity will still be somewhat clouded by as yet unresolved details, but it is necessary to try to discern the facts as best we can, particularly in view of the continuous demand for publication paper of quality exceeding that of the best machine-coated papers now being produced.

Among the factors known to influence coating quality are (1) a group of variables in coating-color composition, e.g., pigments, adhesives, soaps and other additives, per cent solids, pH, rheology at low and high shear, and water release; (2) raw-stock characteristics, including formation and type of formation, strength, smoothness, sizing, pH, moisture content, and instantaneous absorbency, and water-absorbing capacity, uniformity of water receptivity, two-sidedness, porosity, and resilience; and (3) machine conditions as found in different mechanical means of coating, roll pressures, speeds, etc. When confronted with such a formidable array, it may well serve a useful purpose, as it has in the writer's experience, to attempt to single out, if possible, a single, broad, dominating variable to which nearly all others are somehow related, and thus to greatly simplify a very confusing complexity.

In the writer's opinion such an advantage can be found in considering the role of water itself and the many functions which it serves in coating. This has offered a thread of increasingly remarkable continuity in many essential ways. Water is involved not only in the coating-color makeup, governing solids, it is intimately involved in rheology, in the relative hydration of clays and adhesives, its distribution between the competing hydrous colloids being governed by factors such as nature of materials, pH, degree of hydrolysis of starch or protein, additives such as soaps, water demand of clays and other pigments as affected by types and amounts of dispersing agents used. Water relationships are again of paramount importance in relation to raw-stock receptivity and are affected by degree and uniformity of wettability by water, involving sizing, type of sizing agents, pH, moisture content, furnish content, etc. Finally, water plays a dominating role when the coating color is brought into contact with the raw stock whether under pressure or not, a transfer takes place from color to sheet and this appears to involve a culminating and decisive mechanism in coating. It determines the rate of dehydration and solids increase, as well as rheological changes in the coating color during the critical and extremely brief time interval when actual coating is accomplished; it has much to do with the results attendant upon subsequent rheology, such as leveling action, film-split and smoothness, dusting and ink receptivity and, finally, printability.

From the early days of machine-coating problems (*1*), and up to the present, this point of view has been enlarged upon (*2*, *3*) and, as experience accumulates, it appears to gain in its place of importance, and general acceptance (*4*).

The water relationships of raw stocks (*3*, *5*) have also been described in the literature, and will not be reviewed in detail at this time. However, certain observations can now be added as to the role of clay in these water relationships.

Clay, being the main, but by no means the only important, constituent in coating colors, has properly been assigned a dominating role in machine-coating

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behavior, whether good or bad, even though it now shares its position, to some extent, with carbonate and other pigments. Early difficulties in machine coating were overcome through measures taken by the clay producers to blend large amounts of clay and to so process them as to permit of a more uniform water-holding or, as it is now termed, "water release" character. It had been observed, in our early experiences, that the water release, as measured by the simple "blotter test," was subject to enormous variation between various samples of coating clay, and that these water-release values were quite independent of viscosity effects (*1*). When the high-shear devices were subsequently used on clay slips and coating colors made from them (*6*, *7*), it became apparent that, at high shear, the thixotropic body imparted to coating colors by the starch and soap reaction (*8*), was largely destroyed and the rheological character of the clay again became governing at high shear. It may be presumed that some such breakdown of thixotropic body will take place under the conditions of shear in roll coating. We do not have, unhappily, any means of measuring water-release from clay slips or coating colors under dynamic conditions of pressure and shear. But, in measuring the influence of certain variables as they affect water release of clay slips and coating colors at rest, and observing the characteristics of roll coatings made from them, it is possible to note certain relationships which are far more probably significant than the irrelevant attendant accidents.

The problem is somewhat further illuminated in the following way. Employing an average commercial grade of coating clay, it can be shown that at 71%, slips of such a clay, dispersed with a polyphosphate, will not only exhibit wide differences in low and high shear viscosity with various amounts of phosphate, but, at the same time, the water-release and the type of filter cake resulting from the water-release test will show very great differences. Consider the data, for example, in the following table:

	Phosphate, %	*Brookfield viscosity, cp.*	*pH*	*Water release, min.—sec.*
For low shear minimum viscosity	0.25	208	5.8	3—45
For "hi shear" minimum viscosity	0.60	880	6.3	2—15
Same as "hi shear" plus ammonia	0.60	3360	8.2	1—30

The water-release test was made with a heavy filter paper in these experiments. Following the completion of the test, the paper was removed from the slip and the thickness and texture of the filter cake examined. In this, and in many other cases, it was noted that a rapid release was associated with a thick and soft filter cake, very slightly compacted and obviously quite permeable; the slow water release on the other hand, was always associated with very thin and compact filter cakes and, of course, relatively much less permeable. It might be suggested, in passing, that the state of dispersion optimum for low-shear viscosity is quite different from that for high-shear viscosity, and that water release has not the anticipated relationship to "viscosity." It is of interest to note also that the instance of slowest water release, i.e., optimum phosphate for low-shear viscosity, the thin and compact filter cake suggest best dispersion and oriented-particle layer formation with minimum permeability. This particular case must not, however, be accepted as necessarily reflecting the behavior of all samples of coating clay, for the clays can differ naturally in this respect, due to factors which exist in clays and which can now be put under adequate control by clay chemists.

As previously mentioned, adding starch, soap and, perhaps, other pigments to the clay slip, and subjecting the coating color thus formed to pressure and shear in contact with an absorbent sheet, presents an all-important area in water release that has not at present been directly quantitatively examined. In fact, the mechanism is so dynamic, in view of the extremely rapid rise in solids in the coating film, that the problem really appears forbidding. Yet we must presume that such filter cakes do form in coating, the excess being doctored off in certain types of application; or squeezed backward, or becoming involved in film-split, in other types of coating.

DEDUCTIONS FROM COATING EXPERIENCE

Since no physical method now available can permit a direct observation of these dynamic mechanisms, how then can the validity of our deductions be tested? Obviously, only from the collective experience in many mills with many types of coaters, raw stocks, coating colors, and coating types. The trend of such experience is, for example:

1. Smoother roll coatings are often obtained under water-release conditons which favor more, rather than less, dewatering of the coating color at the coating nip. This may reduce tendency for film split, the latter being due to at least a semifluid condition, as the sheet emerges from the nip.

2. Conditions as in (*1*) may well be operative in Hoel (*9*) who found greatly reduced patterning under lighter applicator-roll pressures following heavy meter roll pressures. Roll pressures and shear are this, obviously, of great importance in water release and in filter cake compacting.

3. Unreceptive raw stocks are difficultly coatable under any conditions; they tend to yield poor coating adhesion and produce rough, hard coatings.

4. For high-speed coatings, it appears adverse to good quality to promote a too-fluid or semifluid condition in the coating film following the nip, anticipating that natural leveling action will produce smoothness.

5. The same coating color has been found operative on one raw stock but not on another, and vice versa, just as the same color may be operative or inoperative on the same raw stock, depending upon roll pressures.

6. Many effects as on finish, pick resistance, etc. are directly related to water release, other things being equal.

7. Under conditions of excessive water transfer, due to a combination of very receptive raw stock and the characteristics of the coating color, mineral agents, such as bentonite, are found more effective to alleviate this condition, due to a slowing action or water release by bentonite; probably also the bentonite is better than starch, etc., for this purpose, inasmuch as the bentonite is not as greatly affected by high-shear conditions.

8. Many sets of extremes must be avoided in machine coating; this is nowhere more apparent than in the

matter of water release; each case is peculiar to itself and a proper balance is essential between raw-stock and coating color, in respect to water relationships, any given case being further affected by mechanical conditions of coating application.

9. Alteration of color composition, or of raw-stock characteristics, may require compensating changes to effect uniformity or improved quality coatings.

Thus it appears that sufficient correlation can be found in many aspects of machine-coating experiences to impute a large degree of useful validity to a mechanism so difficult to evaluate directly. This, for lack of a better name, may be called the "water mechanism."

COATING CLAY CONTROLS

As the predominating ingredient in nearly all machine-coating colors, and playing an important part in the water mechanism, how uniform is clay in these respects; is it possible that nature has provided unlimited amounts of clay which are correct and uniform or, as the known reserves diminish, will it be necessary to accept certain deficiencies in quality? Bearing in mind that the modern machine-coated paper and related graphic arts industries have literally been built around the characteristics of the Georgia clays, these questions are indeed pertinent.

These clays occur in huge masses along the "Fall Line" in Georgia; they are the remnants of the ancient alumino-silicates, whose geological and chemical history have imparted certain colloidal characteristics which distinguish them from any clays found elsewhere. They occur in massive strata in numerous separate deposits and in vast quantity. These deposits do not, however, contain clays of identical mineral content, and they differ greatly among themselves, and often within the same deposit, in several of the properties essential to machine coating. In fact, most of the clays in nature are unsuitable as they occur. Procedures of careful mining and blending are employed, however, to insure a remarkable degree of uniformity.

It must be credited to the Georgia kaolin producers that great expenditures of time and capital have been allocated to exploratory and research work over many years, in locating new deposits, exploring their dimensions, and testing the quality by many methods involving mineralogical analysis, thermal curves, x-ray examinations, rheological behavior, including high-shear, bleachability, abrasiveness, sensitivity to processing chemicals, dispersing agents, natural contaminants, particle sizes and shapes, as by electron micrographs. Thousands of samples have thus been secured and evaluated. Not all deposits, by any means, are found satisfactory in all respects; but in studying all types of irregular and "abnormal" clays, much has been learned about the nature of clays, even the "good" clays, that could not have, otherwise, been learned. In fact, by the process of supplementing such findings with continuous research over a period of many years, it has now been found possible to modify clays which may deviate slightly, or even greatly, in one or several important respects, from good coating clays, and thus to bring into the clay reserve many millions of tons of Georgia kaolins which otherwise are without value for machine coating. The domestic coating clay industry has of necessity devised its own technology in close cooperation with the coating mills. No better example could be found of a community of technical interests between two industries, each dependent upon the other.

SUMMARY

When an aqueous clay slip and a starch or protein solution are brought into contact, the two colloids will enter into osmotic competition for the available water. Inasmuch as osmosis is a numbers phenomenon, it follows that the micellar size, among other factors, will determine the osmotic forces. In the case of starch, unpublished observations suggest that clay is the loser in this contest, the starch being much the more active, hydration-wise, the more so the greater the degree of conversion. The partition of the available water must also be influenced by ionic factors such as pH and neutral salt effects. The "blotter" test was improvised to give some evidence of the partition of water between the coating color and raw stock, wherein the swelling pressure of cellulose, modified also by electrolyte conditions and capillary effects, becomes competitive with the osmotic forces of the coating color. The outcome is obviously fundamental in "filter cake" formation, adhesion, film split, and coating quality, in general. Evidence seems to favor the supposition that cellulose is not able to rob the coating color of its water through the liquid phase and as a consequence the adhesive must be forced to some extent into the fiber net work along with the water. In such a case, polar water molecules are actually shared by starch and cellulose fibers, a favorable condition for good adhesive action.

The difficulty of measuring these fundamental mechanisms quantitatively and as they occur under actual roll-coating conditions of high shear and pressures, leaves much research for the future. It would be of value to know the rates at which these colloidal mechanisms progress and the extent to which they proceed in roll coating before drying effects become predominant. We may remind ourselves that in modern machine coating operations, a relatively lightweight coating is applied at considerable pressure and at such a speed that the sheet is in the zone of the coating transfer nip for only about one two hundredths of a second. It will be important to know more about the processes which take place in that brief time interval and immediately thereafter, and how they are affected by raw stock characteristics and all other operating variables.

In the meantime, it will be necessary to continue the use of such of our working hypotheses as have gained credence through usefulness in meeting operational emergencies that do not wait for the final and certain answers. In the writer's opinion, the "water mechanism" continues to gain in value and validity.

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Esterification of Tall Oil

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Whole tall oil was esterified with glycerine at different temperatures for the purpose of obtaining the rates of esterification of both the fatty acids and rosin acids. Some distilled tall oils with varying rosin acid content were also esterified to find the affect of the rosin acids on the esterification. Several catalysts were evaluated for their effectiveness. The affect of temperature and catalyst on the possible decarboxylation of the rosin acids was also studied. Also included are methods for the determination of acid numbers, rosin acid numbers, and saponification numbers of tall oil esters. Glycerine was chosen for these studies because it has been used to such a great extent in this field and for its similarity to many other polyhydric alcohols. It was found that the optimum temperature for the esterification of tall oil with glycerol is about 275°C. Catalysts may quicken the reaction at the start but offer no advantage where low acid numbers (around 5) are desired. The fatty acids are almost completely esterified before the rosin acid esterification becomes appreciable. Very little reaction occurs with the rosin acids until temperatures of about 190 to 200°C. are reached. The high temperature (275°C.) is required to esterify the rosin acids to a low acid number. The amount of rosin acids in the tall oil has very little affect on the rate of esterification. The extent of decarboxylation of the tall oil does not become appreciable until temperatures of over 300°C. are reached.

A GREAT amount of literature is available on the preparation of various tall oil esters. In those cases where the degree of the esterification had been determined, only acid numbers were used. However, acid numbers will give the true progress of esterification if the only reaction is esterification. If decarboxylation of the rosin acids should take place, this will result in a drop in the acid number and be interpreted as esterification. Therefore, one of the objects of this work was to determine whether decarboxylation takes place and some of the factors effecting this decarboxylation. Decarboxylation, if any, could be followed by taking saponification numbers.

Rosin acid numbers were also taken so that the rate of esterification of the rosin acids could be determined.

Whole tall oil and distilled tall oils having various rosin acid content were esterified to find the effect of the rosin acids on the esterification.

Several catalysts that had been suggested were evaluated for their effectiveness.

ESTERIFICATION PROCEDURE

The equipment consisted of a 2-liter round bottom flask equipped with a mercury sealed stirrer, thermometer, gas inlet tubes, sampling tube, and reflux condenser; The flask was heated by means of Glas Col heating mantles (top and bottom); the heat input controlled with two voltage regulators.

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A constant flow of steam was supplied through the jacket of the reflux condenser so that the water formed during esterification would pass on through, whereas the glycerol would be refluxed.

An inert atmosphere was provided by a slow stream of nitrogen at a constant rate. This nitrogen helped in carrying the water vapor out through the reflux condenser.

The passage of vapors as they left the flask was as follows:

1. From the flask the vapors were carried through the reflux condenser and into the water-cooled condenser; most of the water formed was condensed in this condenser and separated out in the water collector.
2. From here the vapors were passed through concentrated sulphuric acid to absorb any water vapor not condensed previously and to polymerize any unsaturated compounds formed due to decomposition, especially acrolein from glycerine.
3. The vapors then passed through an empty bottle, used as an entrainment separator, and then through an absorption tube filled with soda-lime and drierite for the absorption of carbon dioxide that might be evolved.

In all cases the total charge plus the catalyst were added at the start and heated at a uniform rate to the top temperature required. The glycerol used was 15% in excess of that theoretically required, and the catalyst used consisted of 0.3% of the total charge.

METHOD OF ANALYSES OF TALL OIL AND TALL OIL ESTERS

Analyses of Tall Oils

The method used for the analyses of the tall oils was that used by the American Society for Testing Materials. Acid numbers, rosin acid numbers, and saponification numbers were taken using the referee methods. In these methods electrometric inflection end points were obtained with a Beckman pH meter, thereby eliminating the considerable error due to colorimetric end points (*1*).

Analyses of Tall Oil Esters

In searching the literature, no paper was found which gave a method for analyzing tall oil esters so that it was necessary to devise such a procedure.

Acid Numbers

It was found that methyl alcohol alone could not be used as the solvent for dissolving the glycerine ester of tall oil. It would not dissolve the ester and quite a bit of trouble was had due to the fluctuation of the potentiometer because of the fouled electrodes.

Benzene was found to be a very good solvent for the esters, however, its drawback was that it was a poor conductor and very poor results were obtained with the pH meter.

The best results were obtained with a 50% (by volume) solution of benzene in methyl alcohol. This dissolved the esters and steady readings were obtained with the potentiometer.

The ASTM method for tall oil was then revised so that the tall oil ester was dissolved in 100 ml. of a neutral solution of 50% benzene in methyl alcohol, everything else being exactly the same.

Saponification Number

Very much difficulty was encountered in obtaining the saponification number of the tall oil esters. A 0.5 *N* KOH solution in methanol did not completely saponify the ester even after 5 hr. of refluxing. This trouble was due to the rosin esters which resist saponification.

A search of the literature again did not reveal any paper that suggested a method for obtaining the saponification value of the glycerine ester of rosin. It was found, however, that a high temperature was necessary to completely saponify an ester like ester gum.

The solvent that was finally selected was Carbitol (diethylene glycol monoethyl ether) a product of the Carbon & Carbide Corp.

The preparation of the potassium hydroxide in carbitol was the same as the AOCS official method CD 3-25 except that the carbitol (technical) was used in place of the ethyl alcohol.

Table I. Typical Analyses of the Tall Oils Used

	Ligro	*Indusoil*	*Aconew*	*Acosix*
Analysis				
Fatty acids, %	45–50	57–62	89.3	67.2
Rosin acids, %	42–48[a]	33–36	8.5	29.6
Unsaponifiable, %	6–9	5–7	2.2	3.2
Chemical data				
Acid number	160–170	180–185	189.0	188.1
Saponification number	165–175	181–186	193.0	191.5
Iodine number (Wijs)	190–210	62–67	130.0	158.6
Ash %, less than	0.4	0.1	0.05	0.05
Physical data				
Specific gravity 60°F./60°F.	0.97–1.00	0.96–0.98	0.9083	0.9332
Color (Gardner 1933)	Brown		3–4	5
Viscosity (Gardner)	95–210	50–70[b]	A	C–D
Pour point, °F.	45		38	41
Flash point, °F.	380–420	350–380	388	396
Fire point, °F.	420–460	410–430	422	435
Moisture %, less than	0.4	0.1	0.1	0.1
$N^{D}20$	...	...	1.4740	1.4850
Coefficient expansion, per °C.	...	...	0.007	0.007

[a] Calculated as abietic.
[b] Saybolt Univ. at 210°F.
The Ligro (whole tall oil) and the Indusoil (distilled tall oil) were obtained from the West Virginia Pulp & Paper Co.
The Aconew and Acosix (distilled tall oils) were obtained from Newport Industries, Inc.

The procedure used, then, was the same as the ASTM procedure for taking the saponification number of tall oil except that the carbitol was substituted for the

Table II. Data

Run no.	*Time, hr.*	*Batch temp., °C.*	*Water collected ml. (cum)*	*Acid no.*	*Rosin acid no.*	*Sap. no.*	*Adjusted sap. no.*
Run no. 1	0	...	0	149	...	161	161
Charge	1	...	0	139.5			
Tall oil (Ligro)	1.33	215	18.5				
Glycerol	1.77	250	29.5				
No catalyst	2.00	270	40.5				
Heating	2.62	290	52.5				
Temp. incr. to 270°C. in 2 hr. then to 290°C.	3	288	57.5	10.61			
in 1/2 hr. held at temp. of 290°C.	3.42	292	60.5				
	5	290	65.5	6.61			
	6.75	290	65.5	2.83	...	167	158
Increase in weight of soda lime tube 1.9 grams							
Run no. 2	0	...	0				
Charge	0.5	...	0	149.5	...	160.5	160.5
Tall oil (Ligro)	1.0	170	0				
Glycerol	1.5	217	19	107.8			
No catalyst	2.0	257	...	58.7			
Heating	2.25	273	50				
Same as before to top temp. of 275°C.	2.50	275	...				
	3.0	275	59	14.45			
	5.0	278	62	4.170			
	6.42	275	64	1.81	...	167	159.2
Increase in weight of soda lime tube 2.0 grams							
Run no. 3	0	50					
Charge	0.5	...	0	151.2	73.9		
Tall oil (Ligro)	1.0	190	7	133.0	73.8		
Glycerol	1.5	237	31	87.8	70.6		
No catalyst	1.584	249					
Heating	1.701	248	39				
Same as before to top temp. of 250°C.	2.0	248.5	46	51.0	46.8		
	2.084	250					
	3.0	251	54	27.2	24.6		
	5.0	250	61	12.89	10.62		
	6.	252	63	8.95	8.06		
Increase in weight of soda lime tube 2.0 grams							
Run no. 4	0	37.5	0				
Charge	0.28	83	0				
Tall oil (Ligro)	0.5	...	0	153.5	74.5		
Glycerol	0.62	138					
No catalyst	1.0	183	5	138.2			
Heating	1.5	225	29	96.8	70.0		
Same as before to top temp. of 225°C.	2.0	225	38	71.9	62.9		
	3.0	225	44	54.4			
	5.0	225	54	30.2	30.55		
	6.8	225	56	22.35			

Increase in weight of soda lime tube 1.5 grams							
Run no. 5	0	...					
Charge	0.584	...	0	146	...	161	161
Tall oil (Ligro)	1.084	191.5	7	134.2			
Glycerol	1.5	227	26	95.8			
No catalyst	2.0	274	48	45.4			
Heating	2.33	304.5	58				
Same as before to top temp. of 310°C.	3.084	308	66	7.09			
	5.00	310	69	11.92			
	7.25	310	70	17.44	...	151	141.5
Increase in weight of soda lime tube 4.5 grams							
Run no. 6	0	40					
Charge	0.384	...	0	151.2			
Tall oil (Ligro)	0.667	170					
Glycerol	1.0	188	5	145.6			
Catalyst: $ZnCl_2$	1.5	238	32	95.6			
0.3% of total charge—3.66 g. added at beginning with charge	1.75	250					
	2.0	250	53	46.6			
	3	251	67	14.9			
	5	250	72	8.59			
Heating	6.33	251	74	7.41			
Same as before to top temp. of 250°C.							
Increase in weight of soda lime tube 2.2 grams							
Run no. 7	0						
Charge	0.33	...	0	151.7			
Tall oil (Ligro)	1.0	179	7	132.6			
Glycerol	1.5	228	32	81			
Catalyst: ZnO	1.75	250					
0.3% of charge	2.0	253	50	43.3			
Heating	3.0	250	59	18.4			
Same as before to top temp. of 250°C.	5.0	252	62	11.6			
	6.5	252	63	9.13			
Increase in weight of soda lime tube 1.8 grams							
Run no. 8	0	62					
Charge	0.516	...	...	151	76.5	159.5	159.5
Tall oil (Ligro)	0.666	165	...				
Glycerol	1.000	198	12	124.8	76.1		
Catalyst: 0.3%	1.566	247	30	57.1	59.1		
Zinc metal dust	1.599	250					
Heating	2.00	250	43	30.2	32.4		
Same as before to top temp. of 250°C.	3.00	248	54	15.45			
	5.083	250.5	59	7.6	8.59		
	6.5	252	61	...	...	169.8	161
Increase in weight of soda lime tube 0.6 grams							
Run no. 9	0	...	0				
Charge	0.5	...	0	159.2			
Tall oil (Ligro)	0.75	157.5	0				
Glycerol	1.033	186.5	7	134.5			
Catalyst: 0.3%	1.55	236.5	32	81.9			
Litharge	1.667	250.0					
Heating	2.00	246.0	46	51.5			
Same as before to top temp. of 250°C.	3.00	251.0	55	27.0			
	5.37	250	62	9.73			
	6.08	250	64	6.54			
Increase in weight of soda lime tube 0.8 grams							
Run no. 10	0						
Charge	0.183	57	0				
Tall oil (Aconew)	0.333	85	0	180.5			
Glycerol	1.000	175	3	161			
No catalyst	1.50	212					
Heating	1.55	...	29				
Same as before to top temp. of 275°C.	2.00	257	43	47.6			
	2.217	275					
	3.00	277	55	12.75			
	5.084	275	58	3.23			
	6.50	275	...	2.86			
Increase in weight of soda lime tube 0.8 grams							
Run no. 11	0						
Charge	0.367	86	0	175.2	50.4		
Tall oil (Acosix)	0.685	136.5	0	174.0	50.1		
Glycerol	1.00	173	0	164.5	48.9		
No catalyst	1.50	214	22	114.8	46.3		
Heating	2.00	250	42	60.0	38.3		
Same as before to top temp. of 275°C.	2.35	275					
	3.00	273	57	15.48			
	5.116	274	62	3.99	2.94		
	6.084	277	64	2.56			
Increase in weight of soda lime tube 0.4 grams							
Run no. 12	0						
Charge	0.15	50	0				
Tall oil (Indusoil)	0.567	...	...	170			
Glycerol	0.816	158	0				
No catalyst	1.00	178	4	162.5			
Heating	1.5	218	23	108.2			
Same as before to top temp. of 275°C.	2.0	257	37	54.5			
	2.3	282					
	3.0	273.5	52	15.14			
	5.0	275	57	6.83			
	6.5	276	58	5.35			
Increase in weight of soda lime tube 0.5 grams							

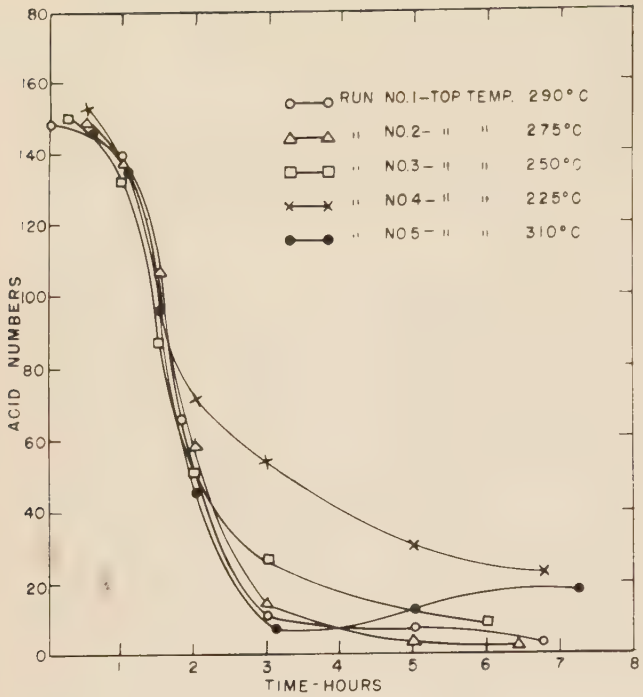


Fig. 1. Esterification of tall oil (Ligro) at various temperatures with glycerol, no catalyst

methyl alcohol in the refluxing operation, all other operations being the same.

Table III. Raw Materials of Batches

Tall oil	*Oil weight, g.*	*Glycerol weight, g.*	*Total weight, g.*
Ligro	1097	118.4	1215.4
Indusoil	1086	131	1217
Aconew	1084	133.5	1217.5
Acosix	1082	135.8	1217.8

A check on the carbitol method was made by taking saponification values after 30 min., 1 hr., and 2 hr. The results on a sample of the tall oil ester (run no. 2) were as follows:

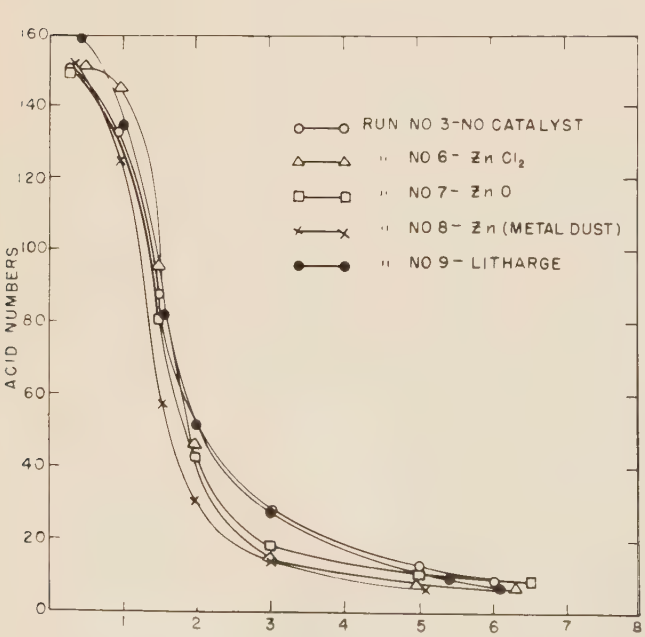


Fig. 2. Esterification of tall oil (Ligro) with glycerol with various catalysts

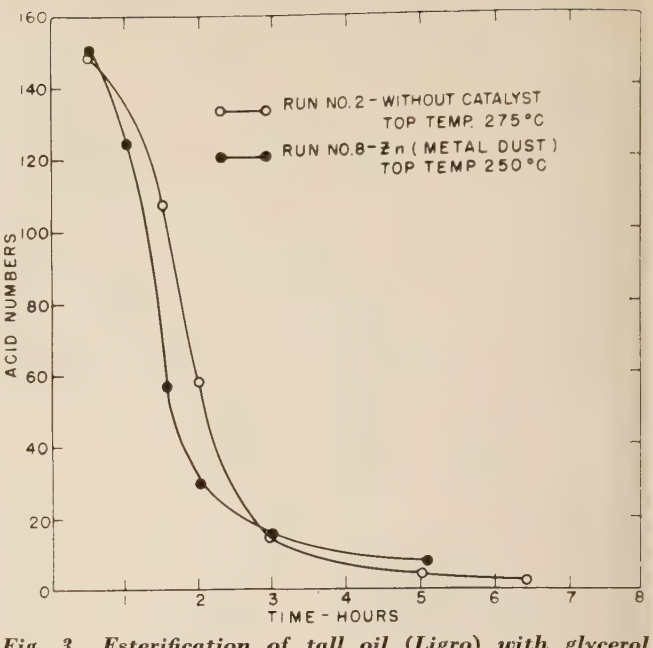


Fig. 3. Esterification of tall oil (Ligro) with glycerol

Refluxing time	30 min.	1 hr.	2 hr.
Saponification no.	167	168.2	167

Rosin Acid Numbers

The procedure for determining the rosin acid number of the tall oil esters was the same as the ASTM method for tall oil. However, in this case, the contents of the flask after refluxing for 2 min. with methyl alcohol were transferred to a 400-ml. beaker with the aid of 100 ml. of 50% benzene-methyl alcohol solution.

DISCUSSION OF DATA AND RESULTS

In all the runs the tall oil, glycerine, and catalyst (if any) were added at the beginning. All the esters were heated to the top temperature at approximately the same rate.

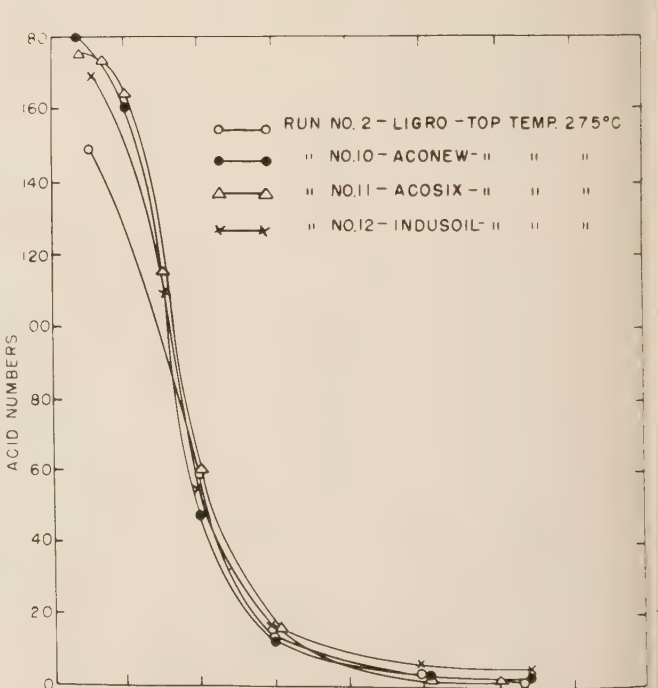


Fig. 4. Esterification of various tall oils with glycerol, no catalyst

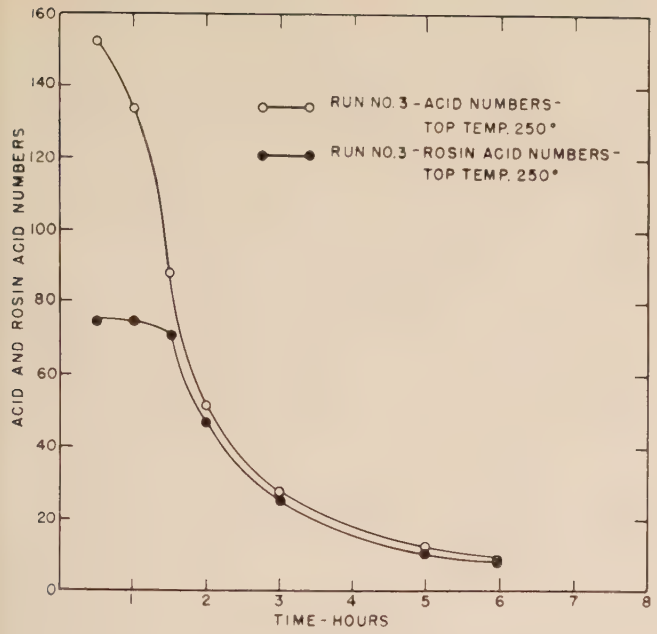


Fig. 5. Esterification of tall oil (Ligro) with glycerol, no catalyst

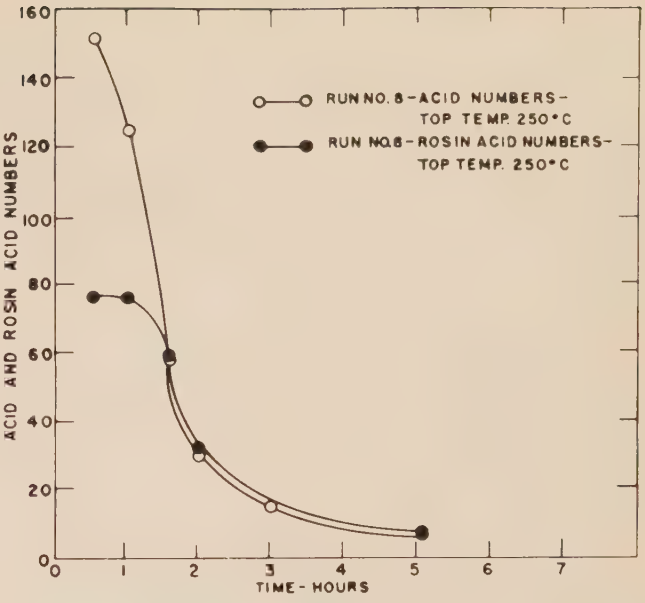


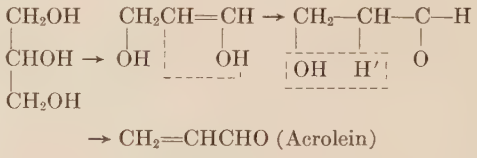
Fig. 7. Esterification of tall oil (Ligro) with glycerol, zinc metal catalyst

Effect of Temperature on Esterification Rate

From the acid numbers obtained during the esterification of whole tall oil (Ligro) with glycerol at 225, 250, 275, 290, and 310°C. without a catalyst the following can be concluded.

The optimum temperature for this esterification is at 275°C. (see Fig. 1, run 2). This fact was noted previously by Mueller, Eness, and McSweeney (*2*). Heating to temperatures higher than this has no advantage and may be even detrimental as can be seen from Fig. 1, run 5, where after 3 hr. of heating (upon reaching 310°C.) the ester began to decompose, that is, the acid number increased. This decomposition continued on prolonged heating at 310°C.

Another fact noted during the various runs was that a yellow compound was formed in the concentrated sulphuric acid absorption bottle. This was probably due to the decomposition of glycerol into acrolein and the subsequent polymerization of the acrolein in the sulphuric acid.



$$\rightarrow CH_2{=}CHCHO \text{ (Acrolein)}$$

The higher the temperature, the greater the decomposition of the glycerol.

Effect of Catalyst on the Rate of Esterification

From the data taken at 250°C. with and without a catalyst it is observed that the catalysts used do not have too much effect, however, as can be seen from Fig. 2 the Zn, $ZnCl_2$, and ZnO catalyst did speed up the esterification of the rosin acids somewhat.

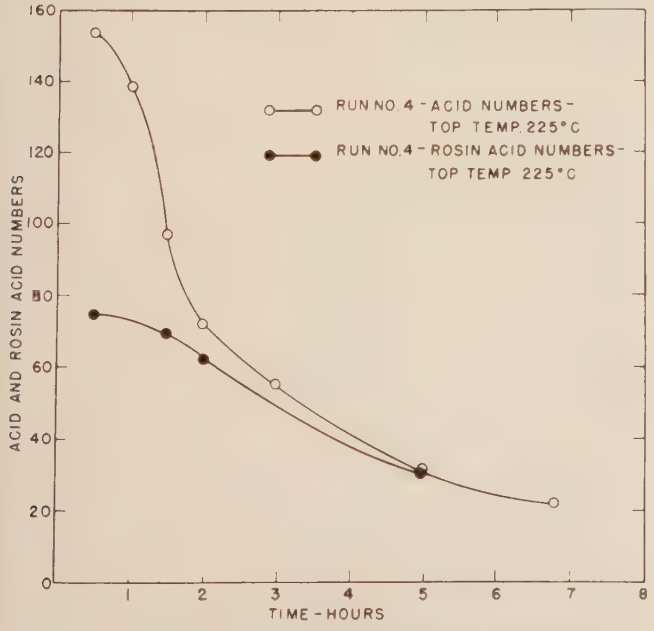


Fig. 6. Esterification of tall oil (Ligro) with glycerol, no catalyst

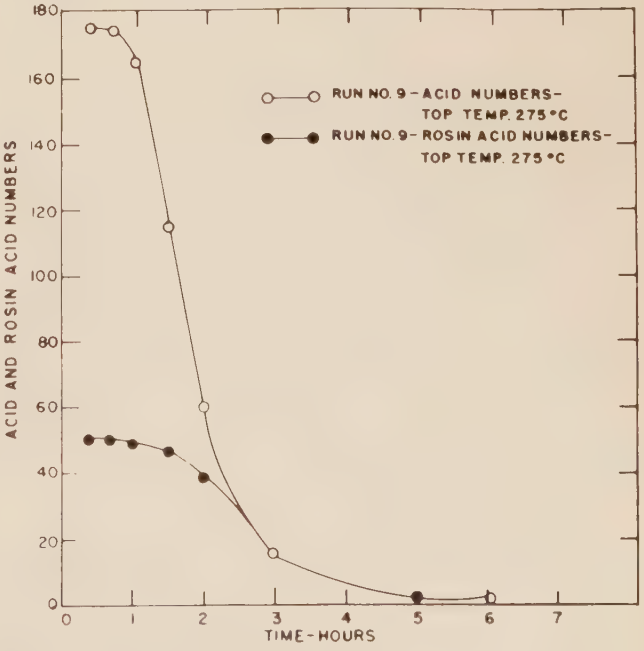


Fig. 8. Esterification of tall oil (Acosix) with glycerol, no catalyst

Litharge, the catalyst mentioned most, had no effect at all.

The best agent was the zinc metal dust. A comparison of the esterification rate at 275°C. without a catalyst and at 250°C. with zinc metal dust is shown on Fig. 3. Here zinc does help in the early part of the esterification, but the rate levels off at the end showing no advantage where the lower acid numbers are desired.

Esterification of the Rosin Acids

Rosin acid numbers were taken on runs 3, 4, 8, and 11 to find the effect of temperature and catalyst on the esterification of the rosin acids. The results are shown on Figs. 5, 6, 7, and 8. From the data and the curves the following was observed:

The high temperature (275°C.) was necessary to esterify the rosin acids to a low acid number.

In most cases the rosin acids did not begin to esterify until temperatures of 190 to 200°C. were attained and then the rate of esterification was slow until temperatures between 235 to 250°C. were reached. Rosin acid esterification was helped slightly by the use of catalysts, but as noted previously did not help in decreasing the acid value to a much lower value. The rosin acids esterification at 225°C. (Fig. 6, run 4) was very slow. A run at 200°C. would probably show very little rosin acid esterification which is in line with Gayer and Fawkes (*3*) who said that the rosin acids esterification does not become appreciable until temperatures above 200°C. are reached.

Esterification of the Fatty Acids

The fatty acids were esterified very rapidly, the rate becoming greatest when 175°C. was reached (after about 1 hr. of heating). The fatty acids were practically completely esterified before the rosin acids esterification became appreciable. It may be appropriate to note here that with the apparatus used the water of esterification started to come over into the water condenser at a temperature of about 172°C. This occurred in all the runs.

Effect of Temperature on the Possible Decarboxylation of the Rosin Acids During Esterification

It has been known that rosin acids on heating are decarboxylated to resenes, this decomposition becoming appreciable at temperatures over 300°C. and occurring at a fast rate at higher temperatures (about 350°C). If during esterification some decomposition takes place and resenes are formed a poor product for drying oils will result. In industrial practice the esterification is carried out until a desired acid number is reached, no indication being obtained as to whether the resin acids were esterified or decarboxylated. It was therefore one of the purposes of this study to find out if the rosin acids were decarboxylated during esterification and the factors effecting this decomposition.

This was done by taking saponification numbers at the beginning and ending of a run. If the saponification value remained constant, then there would be no decarboxylation. However, if the saponification number dropped, then this would be an indication of the decomposition of the carboxyl group. Another indication would be of the increase in weight of the soda lime tube.

Saponification numbers were taken at the beginning and at the end of several runs. For the runs at temperatures up to 290°C. it was observed that the saponification number at the end of the run was higher than that at the beginning of the run. The reason for this apparent increase is that the removal of the water of esterification results in the concentration of the reaction mixture. The final saponification values were adjusted for comparison with the initial saponification values by multiplying the observed numbers by the factor:

$$\frac{\text{Weight of initial charge—weight of water collected}}{\text{Weight of initial charge}}$$

This adjustment brings the saponification number down very close to the initial saponification number.

It was therefore concluded that decarboxylation does not take place at temperatures up to 290°C. The same holds for the run made at 275°C. using zinc as catalyst.

From the saponification values taken on run 5 the other conclusion was drawn. Here the values did drop showing that some decarboxylation did take place. Another indication of this was the fact that the gain in weight of the carbon dioxide was 4.5 grams whereas in all the other runs the increase in weight was not more than 2.2 grams.

Effect of the Rosin Acids Content on the Esterification of Tall Oil

The four tall oils having different rosin acids content (see Table I) were esterified at 275°C. without catalysts. The results as shown in Fig. 4 indicate that the rosin acids content had very little effect on the rate of esterification.

CONCLUSIONS

The optimum temperature for the esterification of tall oil with glycerol is at about 275°C. Higher temperatures than this do not help. Temperatures above 300°C. are detrimental due to the breakdown of the ester plus some decarboxylation of the rosin acids and decomposition of the glycerine.

Catalysts may quicken the reaction at the start but offer no advantage where low acid numbers (around 5) are desired.

The fatty acids are almost completely esterified before the rosin acid esterification becomes appreciable. Very little reaction occurs with the rosin acids until temperatures of about 190 to 200°C. are reached. The high temperature (275°C.) is required to esterify the rosin acids to a low acid number.

The amount of rosin acids in the tall oil has very little effect on the rate of esterification.

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1. American Society of Testing Materials Handbook, Naval Stores D803-44T.
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Revision received Sept. 13, 1955.

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Estimating Costs for White Water Treatment

V. J. CALISE and R. J. KEATING

Proper selection, sizing, and operating of white water treatment equipment in many cases results in the saving of many thousands of dollars per year by the recovery of stock and process water in addition to solving the waste disposal problem. The three most important factors which must be considered before waste treatment equipment can be properly selected are (1) state requirements for pollution abatement, (2) quality of water and the consistency of the stock required for reuse, and (3) the types of equipment available for treatment of the specific waste water. Basically, the choice of equipment narrows down to (1) screen filtration without pretreatment, (2) settling in reclaimers or retention basins with or without chemical treatment for coagulation plus contact with sludge, and (3) flotation involving pre-treatment with chemicals and pressure aeration followed by flocculation and skimming. The cost items which must be considered after basic design information is available are initial cost of equipment, installation costs, chemical and labor costs. These costs must be compared to the savings in water, stock, and heat for proper evaluation of the various systems.

It is the purpose of this article to discuss some of the economic factors entering into the selection and operation of white water treatment equipment in pulp and paper industries.

In some plants, proper treatment of white waters can help solve the problem of insufficient or high cost raw water by providing a supply of clarified water of proper chemical composition. This is of special value where normal surface supplies are insufficient during most of the year or where they are highly polluted and costly to purify. In addition, in many cases, such waste water recovery helps where the underground water table is very low and water is costly to obtain in adequate quantities.

In many cases, the recovery of costly stock from the white water results in savings of many thousands of dollars per year in addition to solving the waste disposal problem.

RESTRICTION ON DISPOSAL OF WASTE WATERS

Most states have adopted rigid regulations prohibiting the introduction of waste into rivers and streams.

The seriousness of the problem of stream pollution by waste waters containing large quantities of pulp and paper stock, mainly cellulosic in nature, is apparent to all pulp and paper mill owners. A great deal of work is being done by this industry and various trade groups so as to conform to regulations of state sanitation boards. In contrast to many industries where usable materials cannot be recovered from wastes, the treatment of white waters can be profitable by recovering pulp and paper stock. State regulations now require reduction of solids in pulp and paper mill waste waters to values low enough to avoid increasing the pollution load on streams and surface supplies. In many cases this means a permissible suspended solids or stock concentration of less than 0.25 lb. per 1000 gal. in the waste discharged into the stream.

More and more states, cities, and towns are establishing regulations limiting impurities which can be tolerated in open streams and local sewerage systems. The assistance of the Federal government is now available to help solve problems presented by the waste waters of industry.

FACTORS IN DESIGN AND COST OF WASTE WATER TREATMENT EQUIPMENT

There are many waste water problems in pulp and paper mills of such complexity and diversity that laboratory research and pilot plant developmental investigations are required before the chemistry of the treatment process and the equipment design are established. However, there are also a number of types of problems and applications where the pattern of waste water composition, chemical treatment, and equipment design are well established on the basis of experience and operating data with existing installations.

The selection of the proper process and equipment for treating such waste waters is mainly a problem in economics. It is the job of the design engineer to select the process and chemical dosages and design the equipment which will yield the required purity of treated water at lowest cost and with greatest convenience in fitting into the existing plant flow sheet.

Aside from the requirements of dependable design and proper performance results, it is usually important to reduce the long-term operating cost of waste water treatment plants to the very lowest values. The factors which enter into the long-term operating costs are: (1) cost of chemicals required for treatment, (2) initial investment required for installed equipment, (3) maintenance of equipment parts, (4) cost of labor for operation of equipment, and (5) possibility of recovering valuable products or reusable water from waste water.

The application of chemical and mechanical skill, combining up-to-date developments and experience with on-the-spot research data will appreciably reduce long-term operating cost and provide an installation best fitted to the specific plant conditions.

TREATMENT OF WHITE WATERS FROM PULP AND PAPER MILLS

The amount of stock comprising both fiber and filler which is discharged and lost in waste waters from pulp

Table I. Stock Concentrations in White Water

Mill	*Amount of white water discharged, g.p.m.*	*Rate of solids concentration, lb. per 1000 gal.*	*Amount of stock (fiber and filler) lost, lb. per hr.*	*Range of pH of white water*
A	400	3–4.5	90	5.5–6.5
B	1400	4–12	500	3.8–5.5
C	2000	2–4	360	5.5–7.0
D	1200	3–6	290	4.0–7.0

V. J. Calise and R. J. Keating, Manager, Industrial Waste Treatment Dept., Graver Water Conditioning Co., New York, N. Y.

and paper mills can be quite high. In Table I the concentrations of stock in white water and waste waters from four mills are shown. In some large paper mills as much as 6 tons and as high as 50 tons of stock, on a dry basis, are lost per day.

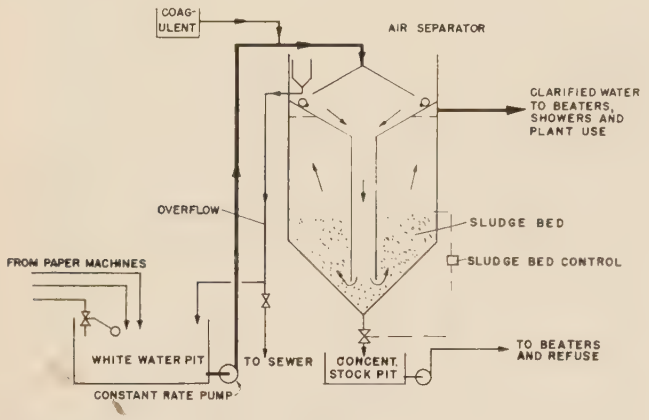

Fig. 1. Simple Graver solids-contact white water reclaimer

The reason for this loss lies in the inability of the fourdrinier wire or any wire used in savealls or other machines to effect a complete separation of suspended solids in water.

There are a number of devices for treating white and waste waters from paper mills. These savealls can be classified by the methods employed in separating fibers and fillers from the water as follows: (1) screen filtration without pretreatment, (2) settling in reclaimers or retention basins with or without chemical pretreatment for coagulation plus contact with sludge, and (3) flotation involving pretreatment with chemicals and pressure aeration followed by flocculation and skimming.

Screen Filtration Without Pretreatment

By this method of treatment, the separation of the fibrous solids is accomplished mechanically by retaining the fiber on a fine mesh wire screen, by using large tanks so that the velocity of flow is so small that the fibers settle by gravity to the bottom, or by adding reagents which float the fibers to the top. With these devices, once the fiber or stock is separated, it is withdrawn from the system and no longer plays any part in the treatment of the waste water.

Although the quality of effluent obtained with these savealls may be satisfactory for some reuse applications, it may not be satisfactory for many cases, particularly where the clarified waste water is employed for showers. For many such applications, concentrations of stock of less than 0.25 lb. per 1000 gal. are required in the clarified waste water. Such low concentrations are obtained in solids-contact or flotation type reclaimers.

Settling in Reclaimers and Retention Basins with or without Chemicals for Coagulation Plus Contact with Sludge

Solids-contact reclaimers make use of a principle which has been employed successfully for many years in the chemical treatment of water supplies. The principle of operation is to provide prolonged contact of the incoming waste water and chemicals with a large concentration of previously accumulated suspended solids. Intimate contact with the suspended solids provides vast adsorptive surface areas to which the coagulated stock particles can adhere. This provides more effective and more complete coagulation while increasing the average size and weight of the stock particles which settle out more rapidly. The result of providing proper contact with solids is the removal of more than 95% of incoming waste water solids in a minimum of time and space.

Simple Reclaimer. Many white waters are of such consistency, by virtue of the presence of weighting agents such as heavy stock, alum, chalk, and resins, that simple settling and gravity concentration of stock can be obtained by reducing the velocity of white water. Such equipment applications result in treated water of 0.25 to 0.50 lb. per 1000 gal. stock concentration.

Figure 1 shows a cross-sectional sketch and flow diagram of a simplified Graver solids-contact reclaimer which can be employed for smaller and intermediate size plants where the nature of the solids is such that agitation, recirculation of solids, and positive sludge scraper solids removal are not necessary and where stock is easily settleable by simple contact with accumulated sludge and settling.

As shown in Fig. 1, there are no internal moving parts in this machine. Incoming white or waste water merely flows over an air-separator baffle and mixes with chemical, if required, in a long, high velocity downtake. The bottom edge of the downtake is designed so that it projects part of the way into the bottom cone. Accumulated solids are suspended by the upflowing water to provide a deep bed of sludge through which waste water and chemicals must pass to flow to the outlet collector. Very low upward settling velocities are employed, surrounding the downtake in this unit and this, together with the lower viscosity of warm water assures maximum settling of coagulated solids. The bed of sludge is maintained at a low point in the unit and a very deep section of wide settling area is provided above the sludge bed to obtain optimum results. Accumulated solids settle down into the bottom of the cone and are automatically blown off to waste.

The equipment and installation costs for this simplified machine are considerably less than those for coagulation and flotation-type units discussed below. This simplified reclaimer is easy to install and can, in many cases, be shipped set up from the fabricator's shop ready for piping assembly or in large prefabricated

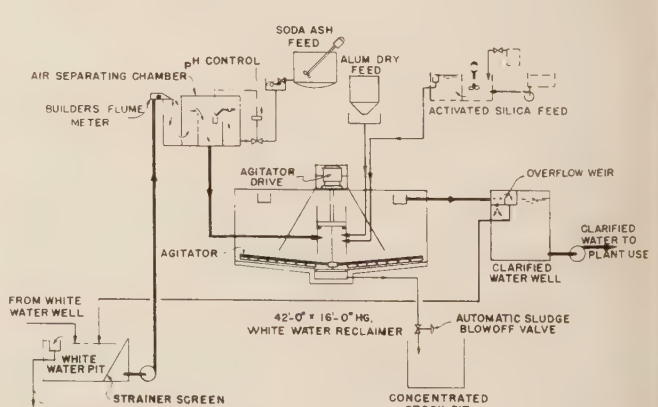

Fig. 2. Typical white water flow sheet using Graver reactivator-type solids-contact reclaimer

parts for easy assembly. It can be located in the open without housing but with a cover in moderate climate and can be easily lagged, where needed, to reduce heat losses. Chemical costs, where chemicals are needed, are very low and usually less than for coagulation-settling and flocculation equipment.

In a recent paper mill application where it was desired to treat 200 g.p.m. of a white water containing 8 to 12 lb. per 1000 gal. of settleable stock, a lined steel reclaimer, 11 ft. 6 in. diameter by 13 ft. straight height was provided. The economics of this application for recovery of stock only were as follows:

1. General Conditions
   - Maximum flow white water..... 200 ± 25 g.p.m.
   - Range of stock concentration.... 8 to 12 lb. per 1000 gal.
   - Range of temperature change of white water..... ±2° per hr.
2. Cost of Equipment
   A unit 11 ft. 6 in. diameter by 13 ft. straight side height, overall height 20 ft., plastic lined steel, assembled, setup unit, alkali feed and pH control, air separation tank, automatic stock blowoff equipment, insulation and cover, inlet and outlet level controls and accessories.
   - Cost of equipment only..... $5500
   - Cost of installation..... 3000
   - Total cost installed..... $8500
   - Amortized equipment cost (10 yr.).....$850 per yr.
3. Performance Results
   Stock is concentrated 30 to 40 times and reclaimer blowoff has 280 to 350 lb. per 1000 gal. of stock mixture. Effluent stock concentration is less than 0.30 lb. per 1000 gal.
4. Chemical and Labor Costs
   - Soda ash 0.3 lb. per 1000 gal. or 90 lb. per day or..... $ 850 per yr.
   - Labor..... $1500 per yr.
5. Total Costs per Year..... $3200 per yr.
6. Savings per Year Due to Installation
   - Recovered, reusable stock (approx. 50% discharged to waste) about 1.3 tons per day at $20 per ton (equivalent price) approx..... $7500 per yr.
   - Recovered, reusable water..... $2000 per yr.
   - $9500 per yr.
   - Net savings per year, $9500 − $3200..... $6300 per yr.

In this plant not all of concentrated stock is reusable and some is lagooned. Also some of the recovered water is discharged to waste. Heat savings are indeterminate at the present time but are additional to above data.

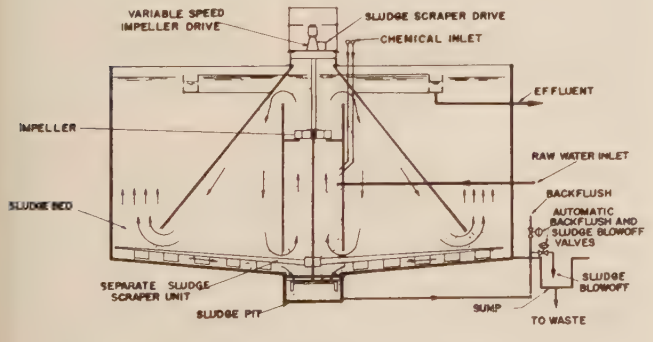

Fig. 3. Graver reactivator-solids contact unit

The above cost analysis shows that, for an investment for installed equipment of $8500 involving chemical and labor costs of approximately $2350 per year, savings of $9500 per year can be obtained. On an amortized basis a net savings of $6300 per year can be obtained in addition to solving an annoying pollution problem.

In other cases where the nature of the white water is suitable, modified settling basins or retention units can be designed in existing facilities or storage basins to

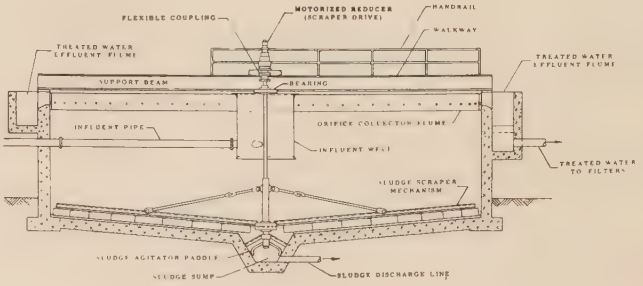

Fig. 4. Graver Roto-Rake thickener

effect comparable results. Proper sludge accumulation areas and sludge blowoff equipment as well as carefully limited settling areas must be designed for this purpose.

Reactivator. Figure 2 shows a diagrammatic sketch of a reactivator-type solids-contact reclaimer and a flow sheet illustrating a typical plant installation. As shown in Fig. 3 an agitator pump is provided in the central uptake of the unit, which mixes water, chemicals, and recirculated solids. Accumulated solids are recirculated by means of this agitator pump at 2 to 6 times the rate of flow of influent to and effluent from the reclaimer. The mixture of water, chemicals, and solids leaves the uptake and enters a conical flocculation zone where particles are permitted to coalesce and chemical reactions are further completed. At the bottom of the conical section the mixture is made to flow upwardly to the collector through a settling section of increasing upward area and, therefore, continuously decreasing vertical velocity. The heavy, large particles are permitted to settle out on the large bottom area and are continuously moved toward a center sludge pit by means of slowly rotating sludge scraper blades. Lighter solids separate from the effluent water stream at the bottom of the conical section and are recirculated up through the central uptake by the agitator pump.

The main features of a solids-contact reclaimer of this type are:

1. Intimate and prolonged contact of solids with the mixture of water and chemicals is provided and can be easily varied.
2. Positive and independent recirculation of previously formed solids by means of the agitator pump is provided. This minimizes the effects on effluent quality of sudden wide fluctuations in flow rate through the unit.
3. Positive movement of settled solids to a concentrated sludge pit is provided by means of rotating scraper blades. This avoids the problem of depending on plant flow rate and vertical hydraulic flow for lifting solids to elevated concentrator pockets. Also, it assures positive removal of all accumulated solids at all times.
4. The very large settling area (virtually the full bottom) of the unit is available for accumulating settled solids. This avoids the problem of location and inadequate size which occurs in circumferential elevated sludge concentrators.

Coagulating chemicals, where necessary, are fed by a proportionating pump or a wet-type proportionating feed. The wet-type proportionating feeder consists as shown in the photograph of an inclined drawoff pipe, the top head of which is suspended by a chain wound

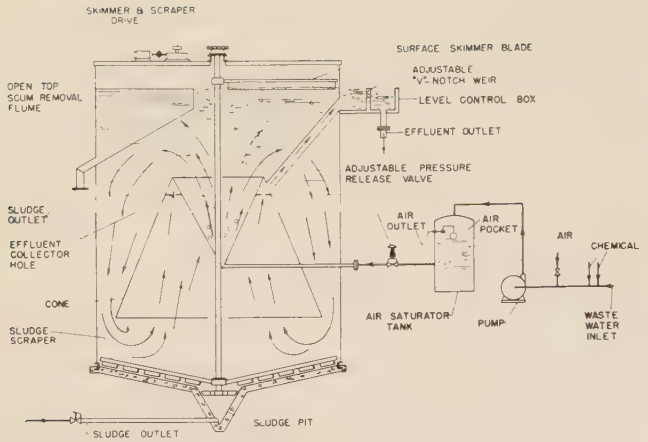

Fig. 5. Graver flotation unit

around the feeding sprocket of the chemical feeding device. A totally enclosed, motor-operated gear reduction unit of special design causes the sprocket to rotate. During operation of the feed, the chemical tank is filled with the chemical solution down the swing pipe at an accurate rate. An inlet flowmeter is usually employed to actuate the device through a contactor and timer arrangement. Feeding rates can be quickly and easily adjusted by remote control.

Although treatment chemicals are required in many cases there are applications where sufficient alum and other coagulants and coagulant aids are present in the waste water itself in sufficient quantities to avoid requiring additional chemicals. This somewhat simplifies plant operation and reduces operating cost slightly.

Economics of Treatment

As an example of over-all cost for treatment of white water by the reactivator-reclaimer, let us consider a paper mill installation where the following conditions prevail:

1. General Conditions

Maximum amount of white water discharged to waste	1200 g.p.m. or 1,750,000 g.p.d.
Amount of stock in white water, average	3 to 5 lb. per 1000 gal.
Temperature of waste water	85°F. summer, 60° F. winter
Treated well water required as makeup, maximum	1200 g.p.m.
Actual cost of treated well water	3¢ per 1000 gal.
Temperature of well water, average	55°F.
Value of stock in white water, equivalent average	$20 per ton

Beaker tests plus observations on the characteristics of the white water and the need for clear treated water indicated that a solids-contact reclaimer of the reactivator-type would produce maximum stock recovery plus clearest effluent.

The installation shown in Fig. 2 will produce a treated water containing less than 0.25 lb. per 1000 gal. of stock.

2. Recovered Products
   Recovered stock—4 (average)—0 25 to 3.75 lb. per 1000 gal. or $\frac{(1{,}750{,}000)\ (3.75)}{1000}$ = 6500 lb. per day or 3.25 tons per day
   Stock is concentrated to 3% by weight in the sludge pit $\frac{6500}{0.03}$ = 217,000 lb. or 27,000 gal.
3. Recovered Water
   Recovered water (total)—1,750,000 − 27,000 = 1,723,000 g.p.d.
   Blowdown of treated white water to waste to maintain total dissolved solids impurities in recirculated water below 3000 p.p.m. − 30% or 500,000 g.p.d.
   Therefore recovered clarified water for reuse—1,723,000 − 500,000 = 1,223,000 g.p.d.
4. Recovered Heat, B.t.u.
   $(1{,}223{,}000 \text{ g.p.d.})\ (8.3) \times \frac{(85 + 60)}{2} - 55 = 183{,}000{,}000$ B.t.u. per day
5. Cost of Equipment
   Outlet flow, 1200 g.p.m.
   Dimension, 36 ft. diameter by 14 ft. straight, $^5/_{16}$-in. steel shell on concrete pad, complete with all internals, controls, and accessories including: wet alkali proportionating feed with pH control, alum dry feed, activated silica feed, air separation tank, concentrated stock blowoff equipment.

Approximate equipment cost	$32,000
Approximate cost of erection and installation (including foundations but no buildings)	$25,000
Approximate total installed cost	$57,000
Amortized equipment cost (10 yr.)	$ 5,700 per yr.

6. Chemical and Labor Costs

Soda ash, 0.3 lb. per 1000 gal. or 600 lb. per day at 3.0¢ per lb.—$18 per day or	$ 5400 per yr.
Alum 400 lb. per day at $6.00 per day or	$ 1800 per yr.
Labor	$ 8000 per yr.

7. Total Operating Costs per Year (approximately) — $21,000 per yr.
8. Savings per Year Due to Installation

Recovered concentrated stock, 3.25 tons per day only, 67% reused in process or 2.1 tons per day × $20 per ton	$42 per day $12,600 per yr.
Recovered water, 1,223,000 g.p.d. at 2¢ per 1000 gal.	$17,500 per yr.
Recovered heat, 183,000,000, B.t.u. costing 25¢ per 1,000,000 B.t.u. or $45 per day or	$13,500 per yr.
Total value recovered reused products	$33,600 per yr.
Savings per year, $33,600 − $21,000	$12,600 per yr.

These calculations indicate that the savings obtained under these particular conditions would permit

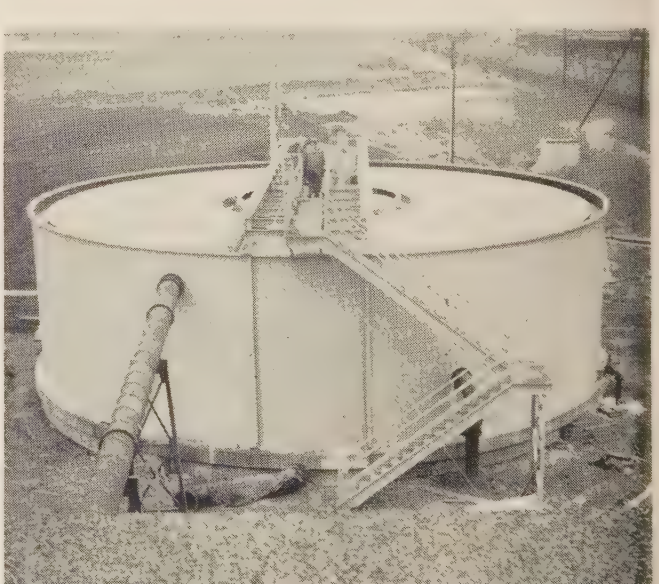

Fig. 6. Graver Reactivator solids-contact unit at an eastern paper company

payment of initial investment in about 5 years and thenceforth would permit savings of approximately $12,600 per year under stated price conditions. In addition, such installation would avoid the problem of pollution of surface supplies. Concentrated stock not reused can be burned or lagooned. Treated waste water can be discharged to waste because it normally contains less than 10 to 20 p.p.m. turbidity.

For a smaller 150-g.p.m. reactivator-reclaimer of similar design, cost of equipment is $11,000 and installation $7500 for a total of $18,500 installed.

Thickener. For many applications where simple thickening of stock is desired and where the clarity of the overflow is not critical, i.e., 0.5 to 0.7 lb. per 1000 gal., a Graver thickener can be employed of the design shown in Fig. 4. Generally this machine is employed for larger flows without chemical treatment or sludge contact. The thickener is frequently more economical in first cost and in operating cost for producing these desired results.

In this design, a simple rotating scraper blade moves the sludge to the center of the machine and thickens. Blowoff of concentrated stock is comparable to that in reactivators and reclaimers as indicated above.

Flotation Involving Pretreatment with Chemicals and Aeration Followed by Flocculation and Skimming

The nature of additives and stock in many white and waste waters is such that downward settling and coagulation with chemicals as well as contact with accumulated sludge does not produce clear effluents within reasonable retention times. Nor does it concentrate the stock sufficiently for the purposes required. In some cases, flotation of the stock and fiber particles by the addition of chemicals plus aeration followed by skimming for concentration is an effective answer to this problem.

Figure 5 shows a typical design of a Graver flotation unit employed in one installation with such a white water problem. This flotation unit actually handles both downwardly settleable particles as well as particles of fiber and stock that normally will not settle or concentrate easily and can be made to float to the top and concentrated by skimming. In the flotation unit, raw water is aerated under pressure to dissolve air in water before entering the flotation machine. Upon pressure release, the dissolved air will come out of solution in the form of tiny bubbles, the size of which will depend upon the aerating pressure or pressure drop at the release point, and the amount of air in solution.

Where a coagulant or flocculating agent is used, the optimum point of addition of the coagulant, i.e., before or after pressurizing, must be determined by actual test. Similarly, if pH adjustment is required, the point of addition of this reagent must also be established in the field. The coagulant or coagulant aid is usually added after the pressure is released and again its optimum point of feeding is adjusted by actual field tests.

After entering the flotation machine the air-entraining flocs or suspended matter will rise to the surface. The concentration of the "float" can be varied by changing the holding time on the surface before skimming. This is accomplished by adjusting the operating water level so as to regulate the quantity being skimmed off by the rotary skimmer.

In many waste waters, a certain amount of heavier solids are usually found. In order to remove these settleable solids, the Graver flotation machine is equipped with a bottom scraper similar to that used in the reactivator. The flow pattern in the flotation unit is up from the draft tube, during which the floating particles rise to the surface; down to the bottom of the separator cone, where the heavy particles settle to the bottom; then up to the clarified water collector. This combination of flotation and sedimentation offers maximum separation of both floatable and heavy particles in one unit.

With sedimentation equipment such as the reclaimer or reactivator, the density of the particles, the particle size, the density of the liquid and the viscosity of the liquid affect the settling rate. In flotation, the relative density of the particles is reduced by physical adherence of small air bubbles so that the particles float to the surface. After floating to the surface, the "float" dewaters partly and is moved to a scum collector trough for removal. Because of the characteristic dewatering of a good "float," it is sometimes necessary to use a flush stream in this collector to maintain sufficient fluidity to permit flow to discharge.

One of the advantages of the Graver flotation unit over the sedimentation unit is the lower cost in some cases for installed equipment for comparable flows of white water. This is generally due to the shorter retention times employed in the flotation unit over the settling-type reactivator, i.e., 20 to 30 min. in some cases for the flotation unit as compared to 50 to 75 min. for the reactivator. However, treated white water from a flotation unit is generally not as clear as that from a well-operated reactivator where turbidities of 5 to 10 p.p.m. (as measured by Hellige turbidimeters) are common.

For this reason flotation units are employed for many applications where extreme effluent clarity is not required and such water is to be reused in process and where stock characteristics indicate best results with flotation equipment.

An economic analysis of the cost factors involved will show equipment and installation costs of approximately 60 to 80% of those noted for the Graver reactivator above for comparable flows. Other values on chemical costs, recovered and reused products are approximately the same.

SUMMARY AND CONCLUSIONS

It has been the purpose of this article to give some indication of the economic factors entering into the selection and use of three basic types of white and waste water treating units, viz., reclaimers, reactivators, and flotation units. Results, operating, and design factors have also been pointed out to give the paper and pulp mill engineer some indication of the advantages and costs of this equipment for a number of typical applications.

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Fiber Length and Beating Control by Classification

JAMES d'A. CLARK

Attention is drawn to some of the advantages of using the weighted average length by weight as a criterion of the length of fibers in a pulp, rather than the numerical average length. The latter is a poor measurement because it depends so largely on the number of the shortest elements present which contribute little to fiber length. Classification compartmental length factors are given for several pulps and it is stressed that unless known, the length factor for at least the coasest screen compartment should be determined for each class of pulp to get an accurate result for the weighted average. The use of arbitrary factors for calculating the coarseness moduli of pulps may give misleading results. The superiority of using a one-screen classifier as a control test instrument for mill beating, and the virtue of using the apparent density of test sheets as a reference for beating research in place of a freeness tester, is discussed in the light of Canadian Standard and Schopper-Riegler freeness and other data from a recent Scandinavian report on a cooperative test on laboratory beaters.

PROBABLY the first and most ancient test used to characterize a paper pulp, was the observed length of the constituent fibers. There is little doubt that if there was an agreed, reproducible, and practical method for measuring the fiber length of pulps, their "length" would be as important and as widely employed as is staple length in the textile industry.

To illustrate the difference between the numerical average length and the weighted average length by weight, suppose that a beater contains a charge of a selected pulp, each fiber of which has a uniform length of 4.0 mm., which is therefore the "average length" of the pulp by any standard. To this is added 5% by weight of fines recovered from whitewater, in which all the fibers have a uniform length of 0.1 mm. What is now the "average length" of the fibers in the mixture? Since each fiber in the whitewater is $^1/_{40}$th as long as those originally in the beater, it is clear that the added solids, which weigh only $^1/_{20}$th of the original beater charge, nevertheless contain twice as many individual fibers. Assuming that the short fibers have the same weight per unit length as the long fibers, after the addition of the whitewater solids, the beater contains only 5% more total length of fiber, but three times the number. Thus, the numerical average fiber length of the beater is reduced from 4.0 to 420/300, or 1.40 mm., that is, by the addition of a mere 5% of whitewater solids, the average length is reduced by 65%—clearly a nonsensical result. On the other hand, the average fiber length by weight in this example, would be reduced from 4.0 to 3.81 mm. (100 parts × 4.0 mm. + 5 parts × 0.1 mm.) divided by 105 parts, —a reduction of about 5%.

INFLUENCE OF LENGTH ON SHEET STRENGTH

It has been found experimentally (*1*), that if other things, including the weight per unit length of the fibers remain constant, the bursting strength of a test sheet is proportional to the weighted average length by weight of the fibers, the tensile strength proportional to the square root, and the tearing resistance proportional to the square root of the cube, of that length. Moreover, these relationships hold whether the fibers are uniformly long or are mixtures of long and short to give the same average weighted length by weight. It was also found, contrary to some opinions, still widely current, that fiber length *per se*, has no effect on either the density of the test sheets or the slowness of the stock. These findings have had some support (*2*), but it would be well if others, particularly those who may doubt them, would do additional work on these basic relationships. It should be emphasized that the variable to be examined in this case is fiber length only, and not also, as is usual when this is attempted, fiber fineness as well, to which many of the supposed effects of cutting have been attributed erroroneously. This misconception has been fostered by the fact that it is virtually impossible to reduce only the length of the fibers without at the same time splitting them in part, and so making them finer, unless the fibers are cut dry and with a razor sharp edge. The pioneer work of Doughty (*3*), was deficient in this respect, since he assumed that the short fibers from a classifier had the same thickness as the longer ones, whereas Graff (*4*) showed later that there is a very good inverse correlation between fiber length and fiber fineness in a sample of pulp. Thus some of the effects Doughty attributed to length, were in fact caused by changes in fiber fineness or thickness.

COARSENESS MODULI

With the development of better fiber classifiers during recent years, more attention is being given to the usefulness of fiber length as a criterion of pulp quality and of beating. Also, to simplify the recording of the results of length measurements, more reliance is being placed on a single number, the "coarseness modulus" or "fiber length index." Ideally, it is thought that this should be the weighted average length by weight, as defined in TAPPI Suggested Method T 233 m-53. Its practical determination involves separating a specimen of pulp of weight W (usually 5 or 10 grams), into five fractions whose weights w and weighted average lengths l are individually found and the result calculated as $(w_1l_1 + w_2l_2 + w_3l_3 + w_4l_4 + w_5l_5)$ divided by W. With a good classifier and rapid drying means, the weights W and w_1, w_2, w_3, w_4, and w_5 by difference, are quickly and easily obtained, but the individual compartment length factors, the l's, require more time and work. Accordingly, arbitary moduli like 4, 3, 2, and 1 are often used for the usual series of screens in place of the true l's, while others depend on factors which have been published in the literature. There is no doubt that these factors will vary with different wood species, particularly those for the longer fractions, which, un-

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Table I. Weighted Average Lengths of Fibers in Compartments After Classification

Pulp	Long, mm.	Medium, mm.	Short, mm.	Very short, mm.	Debris, mm.
Southern pine[a]	3.8	2.7	1.7	0.9	0.1
Western hemlock	3.4	2.4	1.7	0.8	0.1
Ditto (Bauer McNett-finer screens)[a]	3.1	1.7	0.9	0.5	0.1
Second-cut linters	2.3	1.8	1.3	0.9	0.1
Mixed New England hardwoods	None	1.2	0.9	0.7	0.1

[a] Results from author's work, others from laboratory of E. D. Jones & Sons Co., Pittsfield, Mass. Length of all debris estimated at 0.1 mm.

fortunately, are the most influential in the calculated result. They will change appreciably if a moist pulp is dried and then repulped, since the fibers are stiffened by the drying and so are better retained on the screens of the classifier. With long fibers like cotton or linen that fibrillate profusely after beating, a somewhat higher retention may be found in the first compartment because of agglomeration. However, this can be minimized by reducing the weight of the test specimen of very long fibers by about 50%. Despite these and other disturbing influences, if the actual fiber lengths in the compartments are accurately measured and the proper *l*'s established, no errors will be made.

Table I gives a few values for the Clark M-46 Classifier for a 4-min. run, 12 liters flow per min., 5-gram specimen, and a 14, 28, 48, and 100-mesh screen series and one for a Bauer McNett instrument, 15-min. run, 3 gal. flow per min., 10-gram specimen, and a 20, 35, 65, 150-mesh screen series.

Beating does not affect the *l* values very much but they might change appreciably with different species of woods used for pulps, particularly the first or longest factor, often enough to make the use of fixed compartmental factors for all pulps undesirable. For example, from Table I, it is evident that in the first compartment, one could find a much greater fraction of a specimen of cotton linters than from a specimen of southern pine, and yet the length of the entire linter specimen could actually be less than that of the pine.

MEASURING AVERAGE FIBER LENGTHS

A perusal of the literature dealing with methods of measuring average fiber lengths, indicates that, generally, undue emphasis has been placed on the precision of measuring individual fibers, and too little on the need for measuring a large number to get an accurate result. Because the individual fibers in a specimen of pulp have lengths that vary well over a ratio of 20 to 1, a more accurate answer is obtained by measuring a large number of fibers to the nearest millimeter than by the more common practice of measuring a much lesser number to the nearest one-tenth millimeter. It will be obvious that the chance substitution of a 5-mm. fiber for one 0.1-mm. fiber in a small specimen of 50 fibers, would cause a change in the final numerical average length of about 0.1 mm.

If seven categories, with a range of 1.0 mm. having medians of 0.5, 1.5, 2.5, 3.5, 4.5, 5.5, and 6.5 mm. are selected, only those comparatively few fibers whose lengths appear to be near the borderlines need to be carefully measured in order to decide into which adjacent category they should be placed. It is judged that in most instances 300 fibers could be placed in the seven categories more rapidly and with less effort than could a similar specimen of 50 fibers be placed in the equivalent of 50 categories by having to measure their individual lengths accurately to the nearest 0.1 mm. If no systematic error were involved in either determination, the average fiber length calculated from the 300 fibers divided into seven groups spaced by millimeters, would be more accurate than the average length of 50 fibers precisely and laboriously measured to the nearest 0.1 mm. Conversion of the numerical to the weighted average, fiber length, is discussed elsewhere (*1*).

SHARPNESS OF FRACTIONS

Recently a couple of interesting studies on classifiers have appeared. Andersson (*5*, *6*) found that both the Clark M-46 and the Bauer McNett instruments gave much sharper fractions than the Hilbom or H-S apparatus, and that with a 4-min. time for the Clark and 15 min. for the Bauer McNett, the fractions from the former were somewhat less sharp than from the latter. If the duration of the test be only a few minutes, the sharpness of the fractions can be increased by extending the time, and especially so if the flow of water through the instrument is correspondingly decreased. The sharpness of the fractions may also be improved by substituting round-hole perforated screens for the normal square-hole woven screen, but a longer time for classification is needed to offset the substantially smaller open area of the perforated screens. On one trial with a Clark classifier a brass disk with 0.055-in. diameter perforations as closely spaced as practicable, was substituted for the normal 14-mesh screen with 0.046-in. openings (0.065 in. diagonal). After a 4-min. run in both cases, the retained fraction on the plate was appreciably sharper, despite the fact that more pulp was retained, 70.2% versus 58.5% for a West Coast bleached kraft.

Because of the characteristics of pulp fibers, it seems unlikely that any laboratory procedure, apart from microscopic examination, could be devised to separate a specimen of pulp into such sharp fractions that none overlapped. If the validity of Clark's findings (*1*) is accepted that a mixture of long and short fibers make test sheets having substantially identical physical properties to those made from a sample of the same fibers but of uniform length, equal to the weighted average fiber length by weight of the mixture, sharpness of classification beyond a reasonable degree, would not seem to be an important matter for most practical purposes. When one wishes to consider fiber length as a characteristic of a pulp, it is seldom advantageous to have to contemplate its length as represented by a set of five numbers corresponding to the five fractions. If it can be agreed that one composite figure, the weighted average length by weight is enough, provided that accurate compartmental length factors have been obtained for the particular type of pulp and classification procedure, it scarcely matters if the range of lengths of the fractions do overlap, even considerably, and little is to be gained by sacrificing experimental time for an improvement in sharpness.

BEATING CONTROL

For the control of the beating or refining of a substantially uniform type of stock, only the percentage of

the longest fraction (usually that on the 14-mesh screen) needs to be considered. This is so because with most stocks, unless the degree of cutting is carried to almost an impracticable extent, the net effect of beating or refining is to diminish the longest fraction and to increase the shortest fraction correspondingly. The percentages retained in the intermediate compartments remain surprisingly constant. A single screen classifier accordingly is all that is necessary for this purpose. With the improved type, $1^1/_2$ min. is adequate to secure a good separation of the longest fraction. This enables the test to be carried out almost as rapidly and quite as easily as any other beating test yielding a numerical result. The one-screen classification test (which may of course be made with a multiple screen instrument by ignoring the contents of the finer screen compartments) is sufficiently sensitive to detect, with fair precision, the cutting that takes place in a single pass of a strong raw kraft through a normally loaded jordan. Under these conditions a standard freeness would not show much, if any, change.

In a recent series of cooperative tests (7) by leading Scandinavian laboratories which involved nine different kinds of commonly used beating apparatus, with tests in triplicate, the results of sheets made from stock beaten to a constant Schopper-Riegler reading were compared, degrees S.-R. being the accepted standard measure of "hydration" in many European quarters. At the selected reference freeness of 500 ml. or 50°-S.-R., the corresponding Canadian Standard freenesses (which were also determined) for a bleached sulphite pulp with the nine different beating implements, ranged in graduated steps from 149 to 250 ml. C.S.

If this study had been conducted in America where the Canadian instrument is the accepted reference, the stock from the Lampen mill, which at 50° S.-R. had a Canadian Standard freeness of 149 ml. would have been held to have been considerably more hydrated than from the other mills and particularly the Norwegian P. F. I. mill which at the Schopper-Riegler reading of 50° had a Canadian Standard freeness of 250 ml. In consequence, since a direct comparison was made of the strength and other characteristics of identically made test sheets from the stocks from the nine beaters, and which apparently had such a wide range of differences in their "hydration" as 149 to 250 ml. C. S., an American observer could well hold that a direct comparison under such circumstances was invalid. If the pulps had been beaten to the same Canadian Standard reading of, say, 200 ml., the Schopper-Riegler readings would have varied as widely as did the former Canadian Standard readings and a European observer would consider the making of a direct comparison of test sheet characteristics equally improper. For work like this, it is suggested that after plotting sheet characteristics against beating time, the properties of the test sheets should have been compared at some chosen British or TAPPI Standard sheet density, say, 0.75 or 0.8 gram per cc. Then the conclusions reached regarding their relative strengths and the nature of the different kinds of beating would be on a firm, scientific, and comprehensible basis, and have much greater value.

Suppose now that in a mill beating system a comparable extreme change in the production machines was made, and that a Canadian Standard instrument was used in place of the Schopper-Riegler on alternate shifts as a beating control. The Schopper-Riegler user would have been satisfied that the stock from the new system was the same as before—500 ml., but the Canadian Standard man would see his stock as having changed from 149 ml. to 250. He, no doubt, would recommend heavier beating to get the freeness down to 149 ml. Having effected this, his Schopper-Reigler colleague on the next shift would be unhappy until he had his observed reading of around 380 ml. back to 500. On the other hand, if the percentage of long fiber retained on the coarse screen of any two fiber classifiers had been used in place of the freeness testers for the control of the beating in this case, and the results from the two beating systems were identical with one type of classifier, it is certain the long fibered fraction from the two differently prepared stocks would remain substantially identical with the other classifier too and the testers on each shift would not have disagreed. In the case discussed at the beginning of this paper in which 5% of recovered fines were added to a beater, if the original pulp had been moderately or well beaten, its freeness, which is commonly supposed to be an inverse measure of "hydration," but which actually correlates inversely quite well with the percentage of debris present would be reduced by one third or more, merely by the addition of a tiny proportion of normal (not merely short but also very fine) whitewater solids. *Verbum sapiente sat est!*

For these reasons and because a one-screen classification test can be made in the same time as a freeness test, it would appear that a classifier would be a much more reliable as well as a more meaningful instrument for the control of beating than any freeness tester and to a lesser degree, any drainage tester that did not completely simulate all the conditions on the machine wire, including the low head of stock and particularly the washing action of the tube rolls which so effectively prevents any debris present in the stock from having much effect on its true "wetness."

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Note: For a comprehensive survey and discussion of various means of measuring the length of fibers, mainly by optical methods, see Wilson, J. W., *Pulp Paper Mag. Canada* 55, No. 4: 84–94 (April, 1954).

Presented at the 40th Annual Meeting of the Technical Association of the Pulp and Paper Industry, New York, N. Y., Feb. 21–24, 1955.

Erratum

In "Magnetic Amplifier Regulated Drives in the Paper Industry," by M. H. Fisher, Sept. *Tappi*, p. 513, the last sentence of the abstract should read: Over 100 applications of these regulators have been made and over 50% have been placed in service and are operating satisfactorily. The remainder are yet to be installed.

ASSOCIATION NEWS AND EVENTS

Local Section Meetings

Pacific: Jan. 10, 1956, Everett, Wash., Engineering Program; March 2, 1956, Camas, Wash., Shibley Award Program; May 17–19, 1956, Gearhart, Ore., Annual Meeting, Joint meeting with Pacific Div., APPMS Association.

New England: Dec. 9, 1955, Roger Smith Hotel, Holyoke, Mass.; April 6, 1956, Roger Smith Hotel, Holyoke, Mass.; June 8–9, 1956, Oceanside Hotel, Magnolia, Mass.

Southeastern: Nov. 18–19, 1955, Hotel Dempsey, Macon, Ga.; Jan. 20–21, 1956, Francis Marion Hotel, Charleston, S. C.; March 23–24, 1956, Roosevelt Hotel, Jacksonville, Fla.; May 18–19, 1956, King & Prince Hotel, Brunswick, Ga.

Lake Erie: Nov. 18, 1955, Hotel Carter, Cleveland, Ohio; "Quality Control and Testing," Visit to Thomson Products Co.; Jan. 20, 1956, Hotel Carter, Cleveland, Ohio, "Printing Equipment," Visit to Harris Press; March 23, 1956, Steubenville, Ohio, "Production and Process Control," Visit to local paper mills; May 18, 1956, Cleveland, Ohio, Annual Meeting.

Empire State: June 7–9, 1956, Whiteface Inn, Lake Placid, N. Y., Annual Meeting.

Empire State Central District: All meetings held at University Club, Syracuse, N. Y.; Dec. 2, 1955, "Mill Sanitation," by Ralph Russell, Syracuse University, Syracuse, N. Y.; Jan. 6, 1956, "Methods of Coloring Paper," by Maurice Landberge, General Dyestuff Corp., New York, N. Y.; Feb. 3, 1956, "Paper Machinery Developments"; March 2, 1956, "Converting Paper with Plastics"; April 6, 1956, "Papermaking in Europe," by Robert F. Vokes, Dilts Machine Works, Fulton, N. Y.

Empire State Western District: Dec. 7, 1955; Feb. 1, 1956; April 4, 1956; and May 2, 1956.

Empire State Northern District: Dec. 8, 1955, "Printing Problems of the Publisher and New Developments in the Printing Field," by Frank Lincoln, Time, Inc., Springdale, Conn.; Jan. 12, 1956, Students Night, "Beater Additives," by S. Earll Church, College of Forestry, State University of New York, Syracuse, N. Y.; Feb. 9, 1956, "Machinery Developments," by representatives of Sandy Hill Iron & Brass Works, Hudson Falls, N. Y.; March 8, 1956, "Titanium Pigments in Paper," by H. C. Brill, E. I. du Pont de Nemours & Co., Inc., Newport, Del.; April 12, 1956, Empire State Award Night; and May 10, 1956, Annual Meeting.

Empire State Eastern District: Queensbury Hotel, Glens Falls, N. Y.; Nov. 18, 1955; Dec. 16, 1955; Jan. 20, 1956; Feb. 17, 1956; March 16, 1956; April 20, 1956; and May 18, 1956.

Empire State Metropolitan District: Fraunces Tavern, Pearl and Broad Sts., New York, N. Y.; Dec. 13, 1955, "Technical Manpower—Its Opportunities and Responsibilities," by Hugh G. Wyland, H. G. Wyland Associates, New York, N. Y.; Jan. 10, 1956; March 13, 1956; April 10, 1956; and May 8, 1956.

Chicago: Chicago Bar Association Rooms, 29 S. LaSalle St., Chicago, Ill.; Dec. 12, 1955; Social Meeting; Jan. 9, 1956, "New Methods of Printing on Corrugated"; Feb. 13, 1956, "Folding Cartons"; March 12, 1956, "Laminating and Waxing"; April 9, 1956, "Surface Treatment of Paper and Board"; and May 14, 1956, Annual Meeting.

Lake States: Jan. 10, 1956, Northland Hotel, Green Bay, Wis., "Sulphite Spent Liquor Utilization"; March 13, 1956, Hotel Conway, Appleton, Wis., C. J. West Award Program; April 10, 1956, Beloit, Wis., Visit to Beloit Iron Works, Engineering Program; and May 8, 1956, Annual Meeting.

Ohio: Meetings at American Legion Hall, Middletown, Ohio; Dec. 13, 1955, "Printing," by F. A. Weymouth, Interchemical Corp., New York, N. Y.; Jan. 12, 1956, "New Machinery Developments in the Paper Industry," Visits to plants of Black-Clawson Co.; Feb. 14, 1956, "Stock Preparation," by James d'A. Clark, Consultant, Longview, Wash.; March 8, 1946, "Fiber Swelling," by I. H. Isenberg, Institute of Paper Chemistry, Appleton, Wis.; April 10, 1956, Awards Program; and May 10, 1956, Hartwell Club House, Cincinnati, Ohio, Annual Meeting.

Delaware Valley: Engineers Club, Philadelphia, Pa.; Dec. 9, 1955; Jan. 26, 1956; March 29, 1956; April 26, 1956; and May 31, 1956.

Maine-New Hampshire: June 28–29, 1956, Poland Spring House, Poland Spring, Me., Annual Meeting.

Kalamazoo Valley: Hotel Harris, Kalamazoo, Mich.; Dec. 8, 1955, "Mechanisms of Sizing"; Jan. 12, 1956; March 1, 1956, "Testing"; April 5, 1956, "Filler Retention"; May 17, 1956, Western Michigan College Night, Annual Meeting; July 24, 1956, Joint Outing with Michigan Division APPMS Association, Gull Lake Country Club.

Maine-New Hampshire

An important activity of TAPPI is the compilation of routine control methods. To assist the national Association in this work some of the local sections have appointed routine control methods committees. The Maine-New Hampshire Section has appointed the following committee:

H. S. Hooper, Penobscot Chemical Fibre Co., Great Works, Me., Chairman
Lawrence Adkins, Waterfalls Tissue Corp., Mechanic Falls, Me.
A. E. Bachmann, Mississquoi Corp., Sheldon Springs, Vt.
J. G. L. Caulfield, Eastern Corp., So. Brewer, Me.
J. H. Heuer, Great Northern Paper Co., Millinocket, Me.
Elmer Hunting, Fraser Co. Ltd., Edmunston, N. B.
Ross Masterson, International Paper Co., Livermore Falls, Me.
Clifford Myers, Scott Paper Co., Winslow, Me.
E. N. Poor, Hudson Pulp & Paper Co., Augusta, Me.
O. C. Sadler, Pejepscot Paper Co., Brunswick, Me.
P. M. Schaffrath, Oxford Paper Co., Rumford, Me.
F. N. Sprague, St. Regis Paper Co., Bucksport, Me.
R. A. Webber, Brown Co., Berlin, N. H.

Kalamazoo Valley

The TAPPI Kalamazoo Valley Section and the Michigan Division of the American Pulp and Paper Mill Superintendents Association have launched a cooperative program for the 1955–56 season to decrease the number of meetings held each year in Kalamazoo. It is expected that the programs will be better than heretofore.

The first joint meeting was held on Oct. 13–14, 1955, at the Occidental Hotel, Muskegon, Mich. The meeting featured a visit to the mill of the S. D. Warren Co., followed by a graphic arts program.

The annual Papermakers Get-Together which has always been held as a joint meeting will be held at the Hotel Harris, Kalamazoo, Mich., on Jan. 12, 1956.

On May 17, 1956, the joint meeting will feature the recognition of the pulp and paper senior students of Western Michigan College. This will be the annual meeting of the two organizations.

On July 24, 1956, there will be a joint outing of the two groups at the Gull Lake Country Club.

The Kalamazoo Valley Section will hold independent meetings at the Hotel Harris on Nov. 3, 1955, Dec. 8, 1955, March 1, 1956, and April 5, 1956.

Independent meetings of the Michigan Division will be held on Nov. 17, 1955, Feb. 9, 1956, March 15, 1956, and April 28, 1956 (Ladies' Night).

Process Instrumentation and Control

A new TAPPI Committee was established at the Engineering Division Conference held at Houston, Tex., on Nov. 7–9, 1955.

Marvin Cade of the Kimberly-Clark Corp., Neenah, Wis., was appointed chairman. In reviewing the objectives of the committee, Mr. Cade pointed out that it is planned to develop an organization within the Technical Association which will provide a means for the exchange of information based on the knowledge, experiences, and ideas of the instrumentation engineers active in the pulp and paper industry.

It is the intent of the committee to promote papers for presentation at the Association meetings to acquaint other personnel of the industry with the methods, usefulness, and advantages of process instrumentation and control.

The prime interest of the committee will be the application of modern instrumentation and control methods to the processes of the paper industry. In this respect the committee will cooperate with other committees of the Association in the interest of promoting better and more controllable processes. It is also planned that the committee will cooperate with organizations outside of TAPPI, such as the Instrument Society of America and others that indicate an interest in the advancement of instrumentation and automation within our industry.

TAPPI Sustaining Members

The following companies have become sustaining members of the Technical Association in 1955:

Airkem, Inc., New York, N. Y.
Borden Co., Chemical Div., The, New York, N. Y.
Chicago Bridge & Iron Co., Birmingham, Ala.
Foster D. Snell, Inc., New York, N. Y.
Lawrence Pumps, Inc., Lawrence, Mass.
Mississippi Lime Co. of Missouri, Alton, Ill.
Nooter Corp., St. Louis, Mo.
Oldbury Electro-Chemical Co., New York, N. Y.
Smidth, F. L., & Co., New York, N. Y.
Stone & Webster Engineering Corp., Boston, Mass.
Tennessee Corp., Atlanta, Ga.
Thiele Kaolin Co., Sandersville, Ga.
United States Movidyn Corp., Chicago, Ill.

Coating Pigments Monograph

A subcommittee of the TAPPI Coating Committee is preparing a revision of TAPPI Monograph No. 7, Pigments for Paper Coating, under the chairmanship of W. R. Willets, Titanium Pigment Corp., New York, N. Y., and R. W. Hagemeyer, Wyandotte Chemicals Corp., Wyandotte, Mich.

Following is a list of chapter headings and names of individuals in charge of their revision:

Introduction—W. R. Willets, Titanium Pigments Corp., New York, N. Y.
Satin White—R. N. Thompson, Calgon, Inc., Pittsburgh, Pa.
Zinc Sulphide and Zinc Oxide Pigments—V. A. Belcher, New Jersey Zinc Co., New York, N. Y.
Luminescent Pigments—V. A. Belcher
Talc—R. S. Lamar and M. F. Warner, Sierra Talc & Clay Co., Los Angeles, Calif.
Diatomaceous Silica—C. J. O'Neil, Johns-Manville Co., New York, N. Y.
Coloring and Tinting of Aqueous Mineral Coatings—John C. Rice, Lowe Paper Co., Ridgefield, N. J.
Calcium Sulphite—Gerald Haywood, West Virginia Pulp & Paper Co., Luke, Md.
Varnishing Characteristics of Coating Clays and Pigments—John C. Rice
Titanium Pigments—W. R. Willets
Clay—S. C. Lyons, Georgia Kaolin Co., Dry Branch, Ga.
Calcium Carbonate—R. W. Hagemeyer and A. M. Brooks, Columbia-Southern Chemical Corp., Pittsburgh, Pa.

Final drafts of all chapters are to be ready before the February, 1956, meeting.

TAPPI Annual Meeting

The Forty-first Annual Meeting will take place at the Commodore Hotel, New York, N. Y., Feb. 20–23, 1956. Manuscripts of papers to be presented at the meeting should be in the hands of the secretary by Dec. 1, 1955.

The following is a preliminary program indicating the sessions planned to date:

Fourdrinier

"New Developments in Fourdrinier Machines"

Statistics

Plastics

"Water Vapor Permeability," by V. Tammela, C. Rogers, J. A. Meyer, V. Stannett and M. Szwarc, New York State College of Forestry, Syracuse, N. Y.

"The Permeation of Mixed Gases," by C. Rogers, J. A. Meyer, V. Stannett, and M. Szwarc, New York State College of Forestry, Syracuse, N. Y.

"The Effect of Water Vapor on Gas Permeability and Vice Versa," by C. Rogers, J. A. Meyer, V. Stannett, and M. Szwarc, New York State College of Forestry, Syracuse, N. Y.

"The Permeability of Plastic Treated Paper," by R. Bhargava, J. A. Meyer, V. Stannett, and M. Szwarc, New York State College of Forestry, Syracuse, N. Y.

"Factors Affecting the Permeability Constant," by C. Rogers, J. A. Meyer, V. Stannett, and M. Szwarc, New York State College of Forestry, Syracuse, N. Y.

Patents

"Corporate Inventions," by F. Makara, consultant, New York, N. Y.

Acid Pulping

"The Mechanism of the Hot Surface Drying of Paper," by A. C. Dreshfield, Chicago Testing Laboratory, Chicago, Ill.

"The Mechanism of the Dewatering of Pulp Slurries," by R. W. Hisey, S. D. Warren Co., Cumberland Mills, Me.

Technical Manpower

A symposium on technical manpower availability and the paper industry

Fundamental Research

"Surface Chemical Studies on Pitch," The Institute of Paper Chemistry, Appleton, Wis.

Alkaline Pulping

"High Yield Pulps from Tropical Hardwoods of the Brazilian Amazon," by K. Lauer, University of Alabama, University, Ala.

Wet Strength and Interfiber Bonding

"Beater Additives and Fiber Bonding," by J. W. Swanson, Institute of Paper Chemistry, Appleton, Wis.

"Nonwoven Fabrics," by J. J. Osmar, Chicopee Corp., Chicopee, Mass.

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- OK BRAND Thin Boiling Starch
- OK BRAND Oxidized Starches

"Beater Additives," by M. L. Cushing, Stein, Hall Co., New York, N. Y.
"Synthetic Fiber Bonding," by R. A. A. Hentschel, E. I. du Pont de Nemours & Co., Wilmington, Del.
"Wet Strength," by P. Lagally, Linden Laboratories, State College, Pa.

Dissolving Pulp

"The Structure of Cellulose Fibers," by K. Lauer, University of Alabama, University, Ala.
"Loblolly Pine High Alpha Prehydrolysis—Sulphate Pulps," by F. A. Simmonds, R. M. Kingsbury, J. S. Martin, and R. L. Mitchell, Forest Products Laboratory, Madison, Wis.
"Xylan and Mannan Removal During Prehydrolysis, Pulping, Purification, and Nitration," by R. L. Mitchell, M. A. Millett, W. E. Moore, and J. F. Saeman, Forest Products Laboratory, Madison, Wis.
Symposium on the Evaluation of Dissolving Pulp

Water

Symposium on Boiler Feedwater Treatment

Cylinder Board

Structural Fibrous Materials

Microbiological

Preparation of Papermaking Materials

Semichemical Pulping

"High-Yield Neutral Sulphite Pulps," by C. Ceragioli, E. L. Keller, and G. H. Chidester, Forest Products Laboratory, Madison, Wis.

Corrugated Containers

Session on Strength Characteristics of Corrugated Board
Session on the Role of Industrial Engineering in the Manufacture of Corrugated Board
Panel session on problems in the manufacture of corrugated board

Fifth Fundamental Research Conference

The Fifth Fundamental Research Conference was held at the Institute of Paper Chemistry, Appleton, Wis., on Sept. 15–17, 1955. The meeting was jointly sponsored by the Pulp Purification Committee. J. R. Salvesen of the Marathon Corp., Rothschild, Wis., was chairman of the symposium on "The Theoretical Aspects of Bleaching." More than two hundred persons attended. In addition to the U.S.A. and Canada there were representatives from Australia, New Zealand, Tasmania, Finland, Norway, Sweden, and Germany present. Harry F. Lewis, Institute of Paper Chemistry, Appleton, Wis., is chairman of the Fundamental Research Committee.

Part of the luncheon crowd during the symposium on bleaching

H. F. Lewis, receiving the Mitscherlich Medal from Georg Jaime

On Thursday, September 15 two papers were presented at the morning session. "Certain Problems of Bleaching Relating to the Organic Constituents of Wood and Pulp," by Harry F. Lewis and "A Study of the Physico-Chemical Properties of the Alkali-Extracted Part of Chlorinated Sulphate Pulps," by F. Loschbrandt and C. Wetlesen, The Norwegian Pulp and Paper Research Institute, Skoyen, Norway.

R. S. Hatch, vice-president in charge of research of the Hudson Pulp & Paper Co., New York, N. Y., presided at the Thursday afternoon session at which the following papers were presented: "Bleaching I. The Chlorination of Pulp," by D. H. Graugaard, Kimberly-Clark Corp., Neenah, Wis.; and "Multistage Bleaching," by Hansjoachim Leugering, Zellstoffabrik Waldhof, Mannheim-Waldhof, Germany. In addition, Roy L. Whistler of the Department of Biochemistry, Purdue University, Lafayette, Ind., gave a progress report on "Hypochlorite Oxidation of Polysaccharides—Especially Starches."

On Thursday evening a meeting of the Lake States Section was held at the Conway Hotel in Appleton at which the pulp and paper research laboratories of Finland, Germany, Norway, and Sweden were described by Charley Gustafsson, Central Laboratories of Finland, Helsinki, Finland; Georg Jayme, Institute of Cellulose Chemistry, Darmstadt, Germany; F. Loschbrandt, The Norwegian Pulp and Paper Research Institute, Skoygen, Norway; and H. W. Giertz, Swedish Forests Products Research Laboratory, Stockholm, Sweden, and the Technical University, Trondheim, Norway.

W. D. Harrison, vice-president of the Riegel Paper Corp., Milford, N. J., presided at the Friday morning session at which the following papers were presented: "Oxidation of Spruce Periodate Lignin and Lignin Sulphonic Acid with Chlorine Dioxide," by Clifford B. Purves, Division of Industrial and Cellulose Chemistry, McGill University, Montreal, P. Q.; "The Role of pH in Bleaching," by W. Howard Rapson, University of Toronto; and "Chemical Reactions Involved in Bleaching with Sodium Chlorite and Chlorine Dioxide," by Hans W. Giertz, Technical University of Norway, Trondheim, Norway.

George A. Day, chief chemist of the Brown Co., Berlin, N. H., presided at the Friday afternoon session at which the following papers were presented: "Topochemical Chemistry of Delignification During Pulping and Bleaching," by Georg Jayme, Institute of Cellulose Chemistry, Darmstadt, Germany; and "Color Reversion Caused by Overbleaching of the Carbohydrate Fraction of Pulp," by E. B. Marum, Solvay Process Div., Allied Chemical and Dye Corp., Solvay, N. Y.

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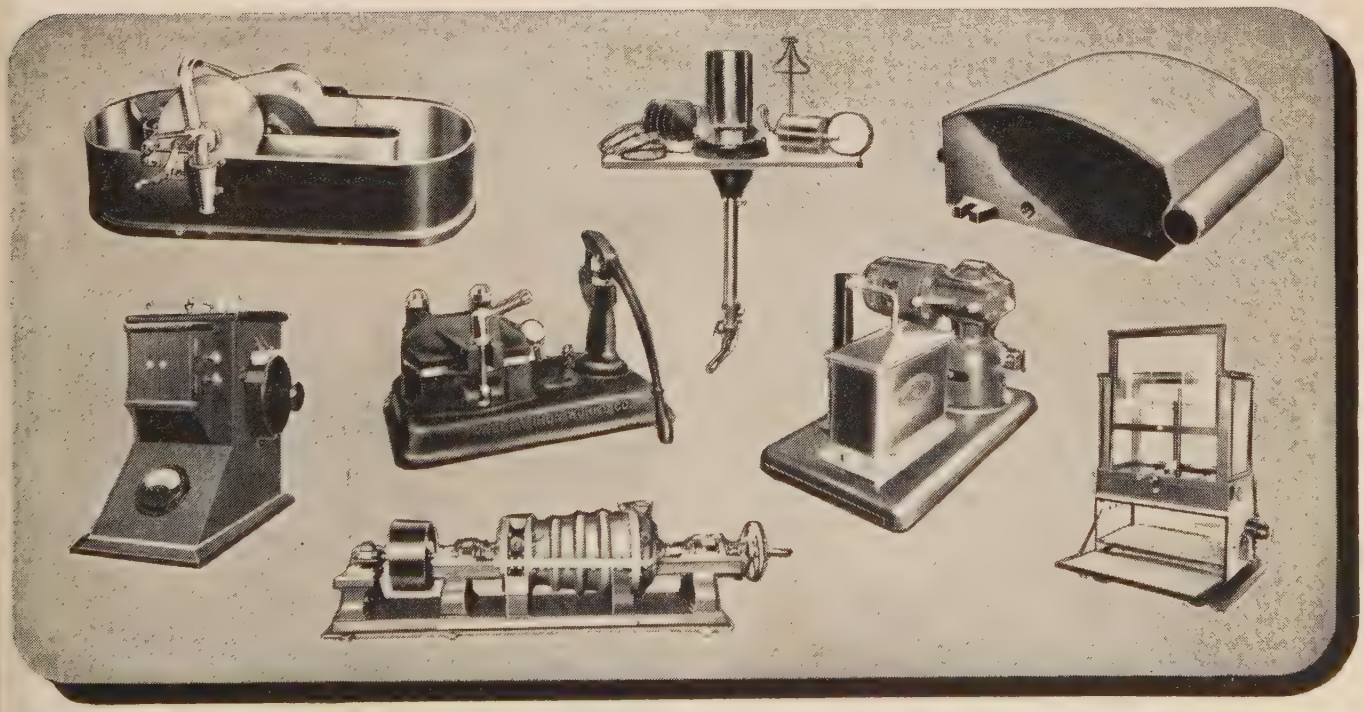

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The papers presented at this conference will be published in subsequent issues of *Tappi*.

Fifth Corrugated Containers Conference

The Fifth Corrugated Containers Conference was held in the Constitution Room of the Morrison Hotel, Chicago, Ill., on Oct. 5–6, 1955. Two hundred and ninety-seven persons registered. K. R. Martin of the Fort Wayne Corrugated Paper Co., Hartford City, Ind., was general chairman. H. T. Scordas of the Union Bag & Paper Corp., Savannah, Ga., is chairman of the TAPPI Corrugated Containers Committee.

H. T. Scordas, Union Bag & Paper Corp.; Chairman, Corrugated Containers Committee

Details concerning meeting arrangements were ably handled by the TAPPI Chicago Section, Arthur C. Dreshfield, Chicago Testing Laboratories, Chairman. A. L. Magnuson, Kelco Co., was chairman of the Local Arrangements Committee. He was assisted by C. S. Macnair, Acme Steel Co., R. W. Porter, *Fibre Containers*, R. D. Carter, Keyes Fibre Co., K. Horita, Container Corp. of America, Mel Snover, Williamson Adhesives, Inc., R. Ueberbacher, American Maize Products Co., and E. Berg, Ace Carton Co.

The Wednesday morning session (October 5) was concerned with "Recent Singleface Innovations" and was moderated by Burt Mendlin, Cornell Paperboard Products, Inc., Milwaukee, Wis. The following papers were presented:

"Adhesive Application on the Singleface and Doublebacker," by Walter M. Goetsch, Samuel M. Langston Co., Camden, N. J.

"Doublefacer Bond—Theory and Practice," by John Harrison, Union Bag & Paper Corp., Chicago, Ill.

"An Operator's Thoughts on Flute Contour," by Harry Wilson, Royal Container Corp., San Francisco, Calif.

"A New Waterproof Adhesive for Corrugating," by L. O. Carlisle, A. E. Staley Mfg. Co., Decatur, Ill., Karl Pottinger, Koppers Co., Baltimore, Md., and J. E. Killinger, Penick & Ford Ltd., Cedar Rapids, Iowa.

"A Waterproof Silicate Adhesive," by R. L. Kreyling, Philadelphia Quartz Co., Philadelphia, Pa.

"Singlefacer Defects and Their Effect Upon the Strength of Corrugated Containers," by J. J. Koenig, Gaylord Container Corp., St. Louis, Mo.

Local Arrangement Committee, Chicago Section of TAPPI. Left to right: Robert Carter, Keyes Fibre Co.; Mel Snover, Williamson Adhesive Co.; Ralph Ueberbacher, American Maize Products Co.; A. L. Magnuson, Kelco Co.; Art Dreshfield, Chicago Testing Laboratory and chairman of Chicago Section

Adhesive panel. L. to R.: Burt Mendlin, Cornell Paperboard Products; J. J. Koenig, Gaylord Container Corp.; Lou Carlisle, A. E. Staley Mfg. Co.; Robert Kreyling, Philadelphia Quartz Co.; John Harrison, Union Bag and Paper Co.; Walter Goetsch, Samuel M. Langston Co.; Harry Wilson, Royal Container Co.

The afternoon session featured "Modern Diecutting Practices." W. P. Blamire of the American Boxboard Co., Grand Rapids, Mich., was moderator.

The following papers were presented:

"Operating Problems in Diecutting and Creasing of Corrugated Board," by G. R. Wilmer, American Box Board Co., Grand Rapids, Mich.

"Recent Developments in Corrugated Board Diecutting Equipment," by Albert Shields, S & S Corrugated Paper Machinery Co., Brooklyn, N. Y.; L. A. Whittaker, Thompson-National Press Co., Chicago, Ill.; Henry W. Moser, Samuel M. Langston, Co., Camden, N. J.; and S. J. Taylor, Thrissell Engineering Co., Contooket, N. H.

"Manufacture of Cutting and Creasing Dies for Corrugated Board," by Seymour Leon, Triangle Steel Rule Die Co., Chicago, Ill.

The meeting closed with a dinner in the Ball Room. K. R. Martin presided as toastmaster. The principal speaker was Cameron Ralston, formerly of the U. S. Bureau of Education whose subject was "The Five Plagues of Democracy."

Thursday, October 6, was devoted to visits of the plants of the American Box Board Co., Stone Container Co., and the Fort Wayne Corrugated Paper Co., all in Chicago.

Features noted at the American Box Board Co. plant at 5950 W. 51st St. were unitized shipment, end-to-end roll storage, and the new S & S folder stitcher.

Following luncheon at the Clearing House Club the group of 175 persons visited the plant of the Fort Wayne Corrugated Paper Co., 4500 S. Kolin Ave., where they saw an 85-in. corrugator with continuous running splicer for paper changes, a no. 585 semiautomatic Bostitch stitcher, and a plant completely conveyerized up to the shipping dock.

Die cutting panel. Seated, left to right: S. J. Taylor, Thrissell Engineering Co.; Seymour Leon, Triangle Steel Rule Die Co.; Albert Shields, S & S Corrugated Paper Machinery Co. Standing, left to right: G. R. Wilmer, American Box Board Co.; K. R. Martin, Fort Wayne Corrugated Paper Co.; Henry Moser, Samuel M. Langston Co.; W. P. Blamire, American Boxboard Co; L. A. Whittaker, Thomson-National Press Co.

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A plant visit group during the Corrugated Containers Conference

At the Stone Container Co. plant the group viewed the Towveyor cable in floor used to eliminate hand trucking; a pneumatic system for production control; hydraulic leveling for truck shipment; and the largest bank of printer-slotters.

The papers presented at this conference will be published later in *Tappi*.

Second International Mechanical Pulping Conference

The Second International Mechanical Pulping Conference was held at Poland Spring House, Poland Spring, Me., Sept. 19–21, 1955. The conference was jointly sponsored by the Technical Section, Canadian Pulp and Paper Association and the Technical Association of the Pulp and Paper Industry, and was the second meeting of groundwood men held by the two associations. The previous conference, in 1948, was also held at Poland Spring. The attendance of 244 at the second conference made it the largest gathering of groundwood men ever assembled anywhere in the world. Delegates were present from all parts of the United States and Canada as well as from Mexico, Italy, Sweden, Norway, England, Australia, and West Germany.

The general chairman of the conference was Thomas F. LaHaise, Imperial Paper and Color Corp., Plattsburg, N. Y. Mr. LaHaise was assisted in planning the conference by the following committee: W. H. de Montmorency, Pulp and Paper Research Institute of Canada, Montreal, Que., and John H. White, Keyes Fibre Co., Waterville, Me., co-chairmen in charge of the technical program; James H. Perry, Norton Co., Worcester, Mass., publicity chairman; Foster H. Fulton, Consolidated Paper Corp., Shawinigan Falls, Que., product display chairman; Arthur E. Jones, Oxford Paper Co., Rumford, Me., local arrangements chairman. Mr. Jones was assisted in making local arrangements for the conference by H. E. Pratt, Pejepscot Paper Co., Brunswick, Me., and J. F. Wright, National Aniline Div., Allied Chemical & Dye Corp., Boston, Mass. T. G. Rust, Quebec North Shore Paper Co., Baie Comeau, Que., and F. W. O'Neil, New York State University, College of Forestry, Syracuse, N. Y., chairmen of the Mechanical Pulping Committees of the two sponsoring associations, acted as advisors to the conference committee.

The program included four technical sessions, six panel discussions, an official banquet, a display of products containing groundwood, and visits to various groundwood mills in Maine. Brief reports of the technical papers are given in the following account of the meeting. The full text of the papers will be published in a later issue of *Tappi*.

Technical Sessions

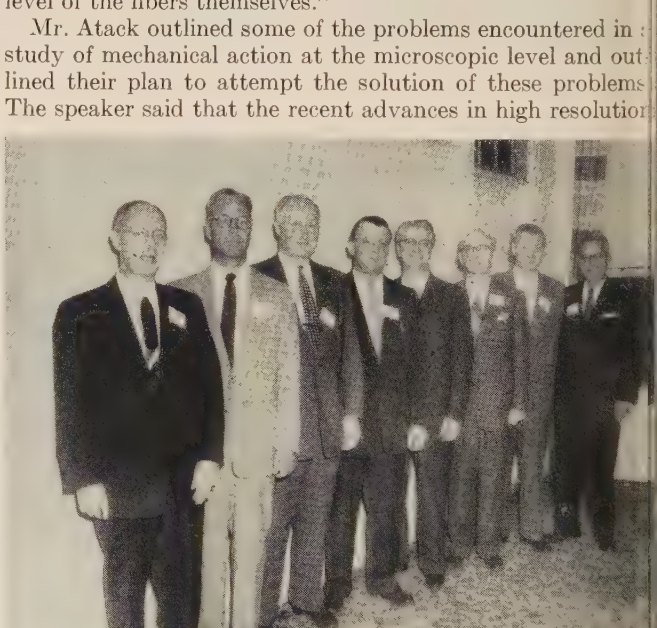
The conference was opened on Monday morning, September 19, by T. F. LaHaise, general chairman. Mr. LaHaise welcomed the delegates from all countries, and pointed out that more than 40 organizations were participating in the conference in one way or another. It would be impossible, Mr. LaHaise stated, to organize a meeting of this kind and scope without the support of these pulp and paper companies, research institutes, associations, and allied industry representatives. The committee was guided in planning the technical program by the excellent response received to a questionnaire sent to all groundwood mills a year before the conference, requesting opinions as to the most important topics for discussion at the conference.

Mr. LaHaise turned the meeting over to Wilfred Gallay, The E. B. Eddy Co., Hull, Que., chairman of the first general session. Mr. Gallay gave the first technical presentation of the meeting on "The Characteristics and Potentials of Groundwood." The approach of most workers investigating groundwood recently has been to attempt to elucidate the mechanism of the grinding process. Mr. Gallay felt that this approach is not sufficiently fundamental, since the production of groundwood by grinding on an abrasive stone is only one of the possible methods of making mechanical pulp. Even before investigating the various methods of comminution, however, Mr. Gallay suggested that considerable work should be done in describing and defining what we mean by mechanical pulp. If we know precisely how to characterize the product we are looking for, we should obtain a clearer idea as to what means is most likely to give us such a product. In characterizing pulp, freeness can be very misleading although it is a useful mill control tool. Fiber diameter and its relation to fiber length, as shown by the work of Brecht and others, is probably of great importance in characterizing groundwood.

The second paper of the opening session was given by Douglas Atack, Pulp and Paper Research Institute of Canada, Montreal, Que.

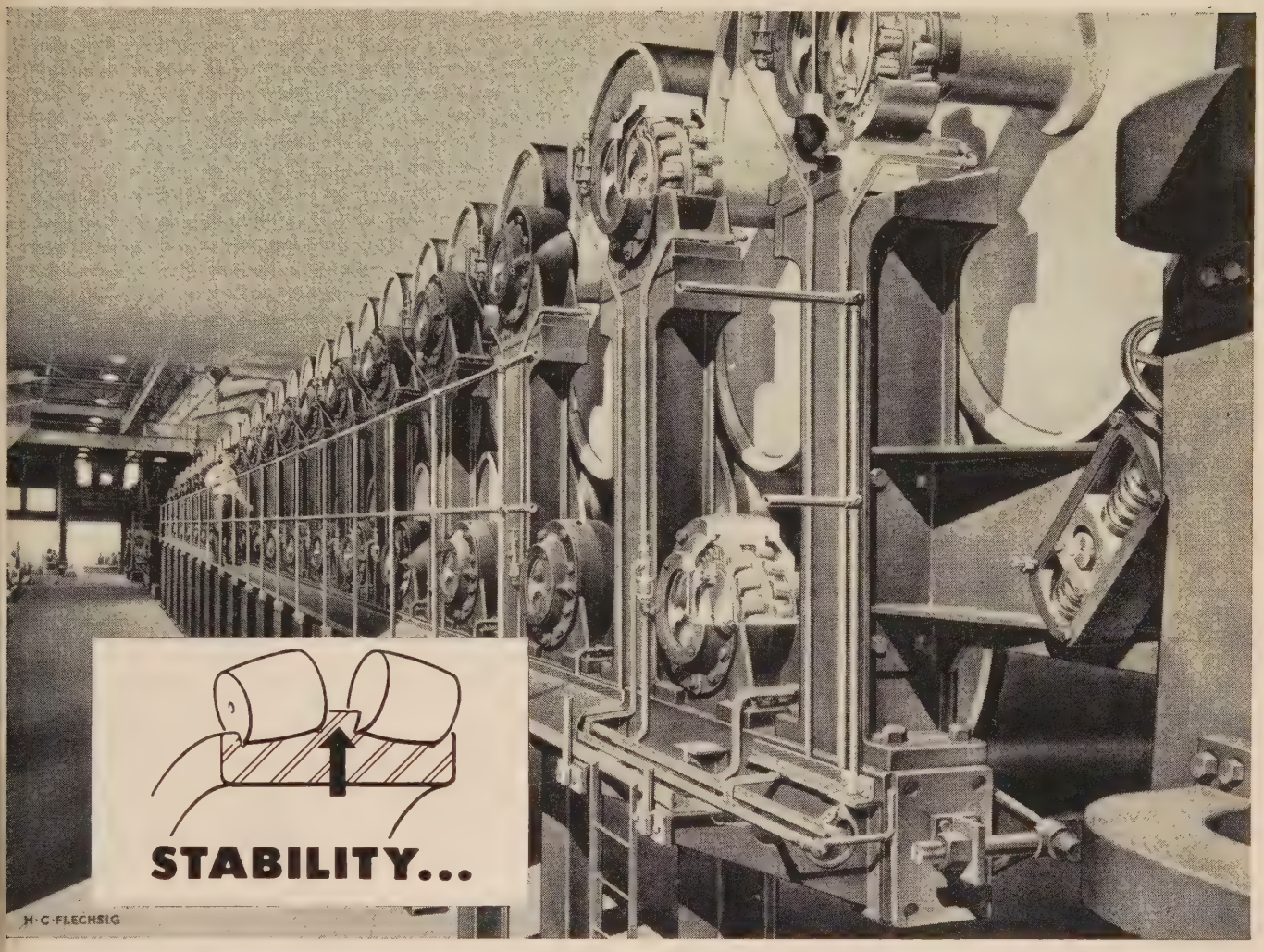
In his paper, Mr. Atack outlined the beating and refining processes in general and described the mechanisms involved in the present groundwood process. Mr. Atack said, "In the present groundwood process fibers are removed from the wood by the mechanical action of the abrasive grits of the stone, and this action occurs in a region which cannot be observed. We feel that the mechanisms involved in the present process may be elucidated only when we have more information about the events which take place at the dimensional level of the fibers themselves."

Mr. Atack outlined some of the problems encountered in a study of mechanical action at the microscopic level and outlined their plan to attempt the solution of these problems. The speaker said that the recent advances in high resolution



A. E. Jones, Oxford Paper Co.; J. H. White, Keyes Fibre Co.; R. G. Macdonald, TAPPI; T. F. LaHaise, Imperial Paper & Color Corp.; Douglas Jones, Technical Section CPPA; W. H. de Montmorency, Pulp & Paper Research Institute of Canada; F. H. Fulton, Consolidated Paper Corp.; and J. H. Perry, Norton Co.

TORRINGTON *Spherical Roller Bearings installed in drier section of Gibraltar Corrugated Paper Cylinder board machine. Drawing—Courtesy of Socony-Mobil Oil Co., Inc.*



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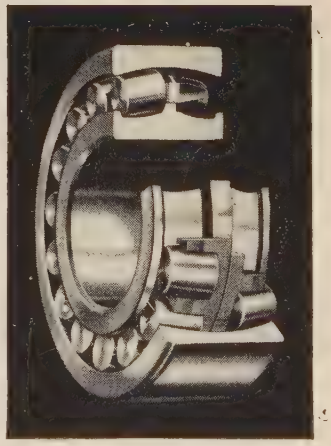
are designed with integral center flange on inner race to provide positive radial stability and positioning for thrust loads



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The head table at the Mechanical Pulping Conference

microscopy should yield many positive results with regard to the size, shape, and surface features of groundwood pulp.

From the purely theoretical viewpoint, Mr. Atack described the numerous types of failure phenomena which occur in grinding in terms of the preferential breaking of certain chemical bonds, and hence, locate certain points or planes of weakness in wood toward this fluctuating force field.

Mr. Atack gave five variables which he said were of primary significance in the problem of failure: (1) the true wood—stone contact area; (2) the true pressure exerted at the contact area; (3) the local temperature in the region of the area of true contact at the time of true contact; (4) the nature of the materials in contact; and (5) the amount and distribution of water.

The speaker said that they intend to make experiments to characterize the extent and nature of deformation produced by high speed indenters simulating single grits. The angle of impact of the grit on the wood, and the moisture content of the wood, will be varied and the cooperative effect, if any, of several grits acting closely together will be determined.

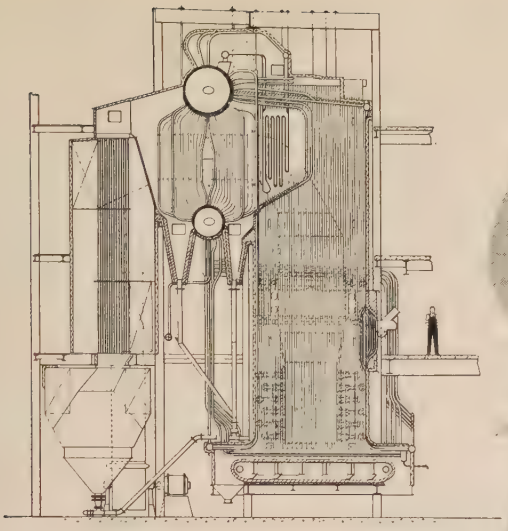
In conclusion, Mr. Atack said, "We believe that we must obtain information at the microscopic level in our preliminary approaches as we feel that analysis of 'large-scale data' alone will not provide an adequate description of grinding. We believe that the data so obtained will supplement the large-scale data and lead to the determination of the basic mechanism of the grinding process."

K. Klemm, Northeastern Paper Products, Ltd., Que., presented a paper on "The Interpretation of Groundwood Production by Fiber Technology."

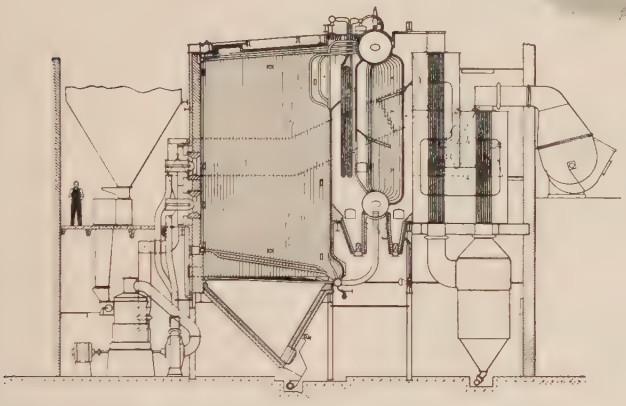
Mr. Klemm discussed new methods of groundwood evaluation with regard to the basic constituents of the pulp in the first part of his paper. Though these methods are too time-consuming to be used for routine control during groundwood production, their application in research leads to a better understanding of what happens during groundwood production.

In the second part, the author developed a working concept for the process of wood grinding and advanced a hypothesis that for good quality groundwood production, the temperatures in the grinding zone should reach the range where the lignin is plasticized (350 to 380°F.) Mr. Klemm demon-

Second International Mechanical Pulping Conference dinner, Poland Spring, Me.



Installation comprising C-E Vertical Unit Boiler, Type VU-40, equipped with C-E Bark Burning Furnace.



Installation comprising C-E Vertical-Unit Boiler, Type VU-50, fired by C-E Pulverized Fuel System.

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Gaylord Container Corp.
Glatfelter Company, P. H.
Great Lakes Paper Co., Ltd., The
Great Northern Paper Co.
Inland Empire Paper Co.
Kalamazoo Vegetable Parchment Co.
Longview Fibre Company
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Minnesota & Ontario Paper Co.
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Ladies committee, Mechanical Pulping Conference. Left: Mrs. T. G. Rust, Mrs. W. H. deMontmorency, Mrs. J. H. Perry, Mrs. J. H. White, Mrs. T. F. LaHaise, Mrs. H. F. Fulton, Mrs. A. S. Jones, Mrs. K. O. Elderkin, Mrs. A. J. Winchester

strated the probability of reaching these temperatures by theoretical calculations and by recent temperature measurements close to the surface of pulpstones.

Related to this concept, the importance of heat economy in the whitewater system of groundwood mills is demonstrated. A decrease of specific power consumption in the range of 2 to 3% per 10°F. increase of white-water temperature will occur. High white-water temperatures become possible by the accumulation of heat in the white-water system when high consistency is provided during thickening of groundwood.

The process involved with the plasticization of lignin is called "preinitial process." It is contingent upon time and, therefore, influenced by the surface speed of the pulpstone and the length of the grinding zone which both determine the "initial grinding time." As indicated by practical experience, this time interval—with regard to good quality groundwood—should be not less than 50 to 60 microseconds.

During the "initial process," the fibers are removed from the presoftened layer of the wood blocks by the brushing effect of the abrasive grits. The rate of movement of wood towards the stone during the "initial grinding time" is the most important feature during this part of grinding. From experience with different grinder types, good quality groundwood can be economically produced if this "traveling rate of wood" is numerically close to the average diameter of fibers of the wood available. The ratio of "traveling rate of wood" versus average fiber diameter is called "initial grinding factor." With high freeness wanted, it may be allowed to be in the range of 1.1 to 1.3; with low freeness, values in the range of 0.7 to 0.9 should prevail. Thus, the capacity of any grinder with regard to favorable quality of groundwood is dependent on the physical properties of wood available and the range of freeness wanted. Relatively coarse grits are favorable for the production of good quality groundwood but, at the same time, the specific energy consumption is higher than with fine grits, all other conditions being constant.

The "secondary process" comprises the refining of the fibers resulting from the "primary process," and the "regrinding." It is highly influenced by the depth of sharpening pattern as effected with the burring of the stones. The ratio of volume of wood to the volume represented by all cavities in the stone surface involved with the actual process, is called "final grinding factor." It indicates the amount of effective refining action which increases with this number and vice versa. However, the amount of reground pulp is additionally involved with this process and thus the influence of grinder pit consistency, submergence of stone, and arrangement of showers is explained.

Because the physical properties of wood as well as the variable conditions involved with grinding process itself fluctuate continuously, the main difficulty during wood grinding is to strike the happy medium which accounts for optimum conditions with regard to these fluctuations. Therefore, for production of good quality groundwood, it is of primary importance to achieve the approximate adjustment for the prevailing conditions by the selection of the equipment and the application of the correct principles of its operation. Secondly, the fine adjustment has to be guaranteed by the skill and responsibility of the operators. It is chiefly related to the conditioning of the stone surface by sharpening.

Wood Utilization Session

On Monday afternoon, September 19, a session on wood utilization was held under the chairmanship of F. W. O'Neil, New York State University, College of Forestry, Syracuse, N. Y.

"Conservation and Utilization of Wood for Mechanical Pulping" was the title of the first paper, by Ralph W. Marquis, Northeastern Experiment Station, U. S. Dept. of Agriculture, Upper Darby, Pa.

Mr. Marquis stated that a general review of the pulpwood situation for the nation, with specific illustrations from the northeast, shows that many of the species in greatest favor for standard methods of mechanical pulping are also in great demand for other uses, and consumption of these species is considerably greater than current net growth. If this situation continues, these favored species will eventually be in very short supply, and purchased pulpwood will command high prices. If no adjustments are made, mechanical pulp production will inevitably decline.

Any, or all, of several possible developments may bring the needed adjustments. Current excessive demand for the favored species may be reduced by substituting other species, both by the mechanical pulpers and by other processors now competing for the prized wood. Supply may be extended, either through greater use of woods and mill residues of the favored species, or through more intensive forest management practices by owners of land suited to the production of these favored species.

The short-run problems can probably be met by the use of new processes that will utilize alternate species, principally hardwoods; and through the use of residues. Eventually, if population and demand increase as expected, increased forest production may be required.

In the past, producers have dictated what material they would take from the forest. Today, the forest is beginning

D. M. Chisholm and Mrs. M. S. Kraft, Norton Co.; C. Anker, Risor, Norway; and Karl Pingrey, Diamond Match Co.

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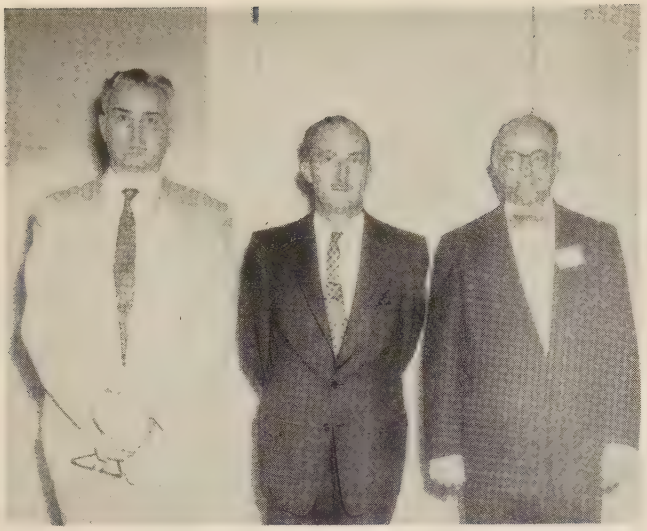


N. F. Robertson, West Tacoma Newsprint Co.; G. E. Shipman, Donnacona Paper Mills, Ltd.; and C. C. Porter, Southland Paper Mills

to have a voice in this. In the future, the forest may dictate what processors will use. It is not too early to start shaping the forest to our future needs.

"Grinding Pretreated Hardwoods: Experiments on Quaking Aspen, Sweetgum, Red Alder, Black Tupelo, Sugar Maple, Red Oak, and Cottonwood," was the title of the second paper, by Axel Hyttinen and E. R. Schafer, Forest Products Laboratory, Forest Service, U. S. Department of Agriculture, Madison, Wis.

Mild treatments with neutral sulphite solutions before grinding increased the freeness and the long fiber fraction of several hardwood groundwood pulps, the authors stated. Strength, brightness, and density were only slightly affected.

Increasing the severity of the pretreatment increased the strength and density of the pulp and decreased the brightness and the opacity of the papers in which it was used. Chemigroundwood pulps were made that approached neutral sulphite semichemical pulps in strength and could probably be used for about the same purposes.

The darker chemigroundwood pulps were easily brightened with a single-stage hypochlorite treatment. The experiments indicate that it may be possible to substitute hardwood chemigroundwood pulps entirely, or in part, for softwood groundwood in newsprint, book, and toweling papers and also to substitute mixtures of hardwood groundwood and hardwood chemigroundwood for softwood groundwood.

"Caustic Treatment of Aspen Groundwood" was the subject of the next paper, by W. J. Foote and S. R. Parsons, Consolidated Water Power and Paper Co., Wisconsin Rapids, Wis.

In this paper the authors cited examples of the strengthening of groundwood by treatment with alkali and described the various patents now in use in this connection.

In a series of tables accompanying the paper the authors showed the effect of several variables on the results obtained in the caustic extraction of aspen groundwood, results obtained in the hypochlorite bleaching of aspen groundwood with and without caustic treatment of the groundwood prior to the bleaching effect of increasing the alkalinity in the caustic extraction stage while holding constant the hypochlorite and alkalinity in the bleaching stage.

The authors reported that spruce groundwood is not so receptive as the aspen groundwood to either strengthening by the action of caustic or to hypochlorite bleaching.

J. H. Heuer, Great Northern Paper Co., Millinocket, Me., presented a paper on "Commercial Production of Chemigroundwood for Newsprint." In his paper, Mr. Heuer presented a brief history of the chemigroundwood process at the Great Northern Paper Co. as well as the details of the operation of the 50-ton pilot plant equipment as well as the present 400-ton unit.

The author said that the advantages of the chemigroundwood process included (1) lower capital cost because a chemical recovery system and bleach plant were eliminated, (2) the re-use of liquor by fortification helps alleviate the stream pollution problem, (3) 85 to 90% yields are obtained in the chemigroundwood process as compared with 45 to 70% for kraft and semichemical processes, (4) the production per grinder was double that of spruce and fir groundwood with corresponding power saving, (5) the use of hardwood results in higher yield per cord of wood and consequently lower wood cost per ton of pulp. In this connection, he said that 1900 pounds of pulp per cord are obtained from poplar and 2800 pounds per cord from maple, birch, and beech.

In his paper, Mr. Heuer discussed the variables and problems which were encountered in developing the commercial production of chemigroundwood for newsprint. These included: (1) The problem of penetrating woods with moisture content in excess of 30% A.D. basis. A solution was found by using a preliminary impregnation period followed by blow-back into the accumulator, then by a vacuum and shortened cooking cycle to increase liquor penetration with resulting increased pulp strength. (2) The variables encountered in the chemigroundwood cooking process including the pulpstone properties and the best way of grinding.

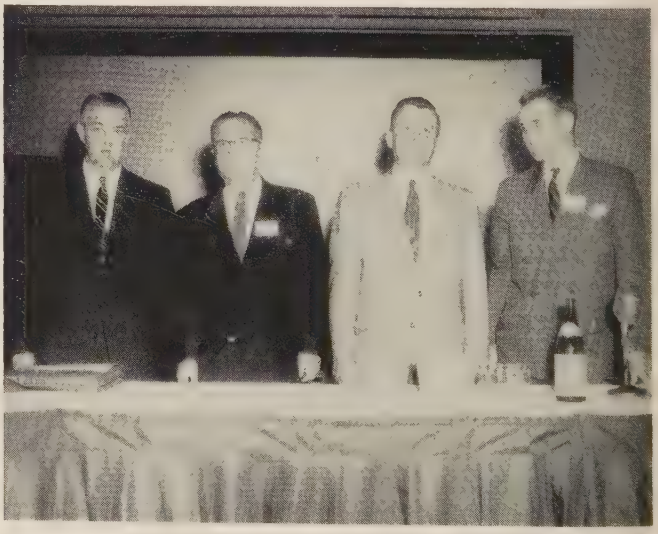
In his paper, Mr. Heuer expressed the opinion that "pilot plant studies now under way, indicate that it may be possible to produce unbleached chemigroundwood pulps from 5 to 10 points higher in brightness than is presently being obtained commercially."

The author said that on the new machine operating at 1800 f.p.m., the furnish is 58% groundwood, 30% chemigroundwood, and 12% sulphite.

In a brief question period following his paper, Mr. Heuer made the following response:

The chemical composition of the chemigroundwood is 10% per ton of pulp; that the temperature of the grinder is about 140°F. beyond which there will be a start to darker pulp; that cool wood is preferred for the grinding; that the stone is burred about every two days; that no difficulty is encountered in penetrating birch and poplar woods, but there is with maple.

Mr. Klemm then presented some brief details and illustrations regarding results from tests made by Walter Brecht on soft and hardwood grinding at the pulp and paper laboratory in Darmstadt, West Germany.



K. Klemm, Northeastern Paper Products, Ltd.; W. Gallay, The E. B. Eddy Co.; T. F. LaHaise, Imperial Paper & Color Corp.; D. Atack, Pulp & Paper Research Institute of Canada

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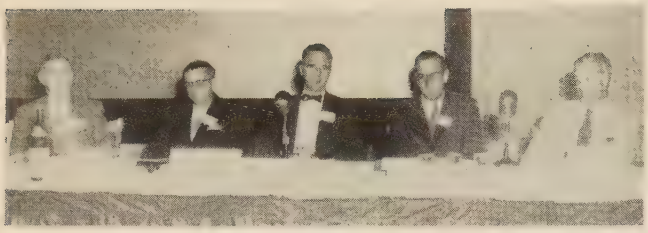

C. Malcom, E. B. Eddy Co.; H. Jacques, Vanity Fair Paper Mills; H. W. Hillier, Scott Paper Co.; R. E. Kissel, Charmin Paper Mills; E. Johnson, Stevens & Thompson Co.

J. L. Parsons, consultant; R. A. Whitman, Scott Paper Co.; A. A. Yankowski, Kimberly-Clark Corp.; D. B. Sparrow, Scott Paper Co.; and C. A. Richardson, Blandin Paper Co.

Tuesday, Sept. 20, 1955

A general session was held on Tuesday morning with Karl Pingrey, mill manager, Diamond Match Co., Ogdensburg, N. Y., as Chairman. He presented C. Anker, Risor, Norway, who presented facts on the work of the Norwegian Pulp and Paper Association on "pitless grinding," which started in 1938 in an effort to get away from the problems of conventional grinding. Mr. Ankers said that on the conventional grinder, as the stock in the pit thickens it follows the stone around and prevents the grit from doing a good job, and it also encourages the stone to flatten and form a film of slime. In the "pitless" system, Mr. Ankers explained, the pit is lowered and the stock is prevented from rising to accumulate on the stone.

"The Norton–Great Northern Research Stone" was the final paper at the general session. This paper reported on the vast, detailed, and lengthy research that has been done to determine stone factors that produce the best quality pulp. It was prepared by Mrs. M. S. Kraft, Norton Co., Worcester, Mass., and K. H. Kalbfleisch, Norton Co. of Canada, Ltd. Presentation of the paper was made by D. M. Chisholm, Norton Co., Worcester, Mass., and the illustrations were explained by Mrs. Kraft.

In presenting Mr. Chisholm to read the papers, J. H. Heuer, Great Northern Paper Co., stated that Norton Co. has thus far spent upward of $125,000 in gathering data on this Research Stone and how it should be set up in the Great Northern Grinder. He said Norton Co. furnished all the controls and instrumentation and collected a great mass of data on which it has taken the Norton Research staff 9 months to analyze to permit presentation of the facts in the paper read here. He added that there are still months of analysis to come.

Panel Sessions

The first of the panel sessions opened in midmorning with W. J. Foote, mill manager, Consolidated Water Power & Paper Co., Stevens Point, Wis., as moderator. The panel members were M. J. Anderson, Oxford Paper Co., Rumford, Me.; G. A. McCracken, Provincial Paper, Ltd., Port Arthur, Ont.; W. J. Walker, Champion Paper and Fibre Co., Pasadena, Tex.; R. Fallon, St. Regis Paper Co., Deferiet, N. Y. The subject matter was "Regional Aspects of Production of Groundwood for Printing and Specialty Papers."

Between members on the floor and panelmen there was a discussion of the types of woods used in different sections of the United States and Canada.

It was brought out that slower grinding is not necessarily better for good sheet surface results; that very little speed change is made on the machine for groundwood furnish; that poplar is ground separately; that in grinding two species the grinding is done to suit the mill's screening facilities; that green balsam hurts the printability of the sheet; that the groundwood furnish on a machine is not the only part of the over-all furnish that controls end results; that nothing in printability characteristics had been lost in the semichemical groundwood furnish, though a point was dropped in opacity which can be corrected by more refining.

There was a lengthy discussion of the times for burring the stone and the number and types of burrs. There was comment that the same grade of pulp was made on stones with grit ranging from 65 up. One mill found no need to change burr size and stone treatment after introducing refiners into the system.

Another mill found that a single burr on a single grit was more efficient in the long run than with cross burrs. The grit range was 54 to 70. It was stated that how one uses a burr, and not the burr makes the difference. Caution was suggested so as not to disturb the stone face in burring to avoid trouble, and keep pressure light. The grit is an influencing factor and the burr operation should definitely be a precision operation regardless of the type of burr used. It was stated that the most successful mills consider it a precision job. The design of the grinder also was stated as a factor.

Neil F. Robertson, mill manager at West Tacoma Newsprint Co., Steilacom, Wash., was general chairman for the panel sessions on board and container and tissue and toweling, on Tuesday afternoon. W. H. de Montmorency, Pulp and Paper Research Institute of Canada, was moderator of a panel session on the production of groundwood for board and container grades. Members of the panel were: I. Gehring, Oswego Falls Corp., Fulton, N. Y.; C. Campbell, Fraser Companies, Ltd., Edmundston, N. B.; C. Malcolm, E. B. Eddy Co., Hull, Que.; T. Phillips, Missisquoi Corp., Sheldon Falls, Vt. The members of the panel discussed the method used to produce a range of freeness grades of groundwood for use in their mill. Two methods of control of the ranges were presented; one, by the use of selective screening and the other, the control of the stone surface. Some members found it necessary to provide a slower stock for summer use. The opinion was expressed that groundwood in the furnish was beneficial for printing with flat inks but caused trouble when gloss inks were used. Three methods were mentioned as being used to control groundwood quality for board manu-

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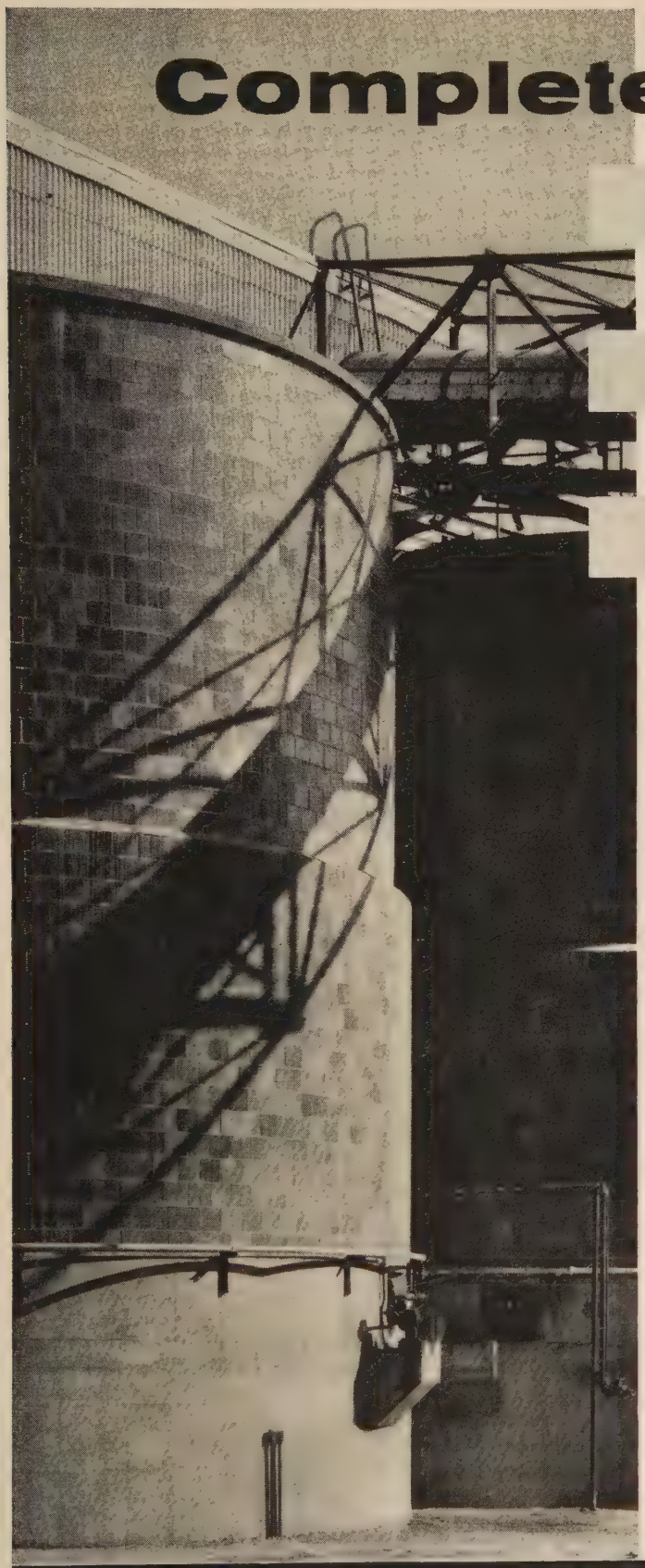

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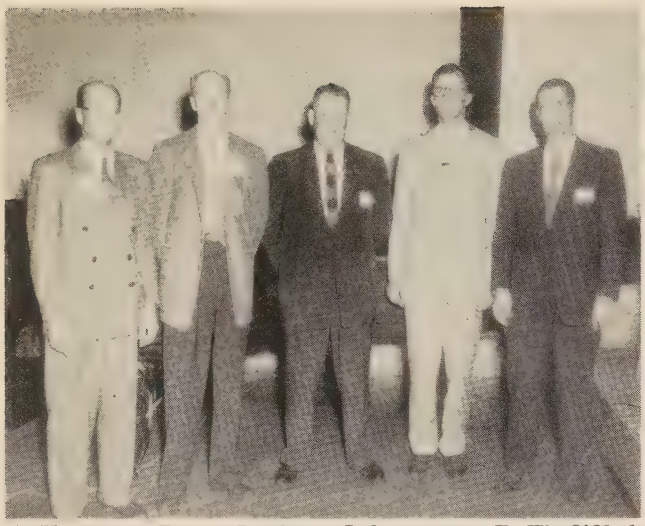


A. Hyttinen, Forest Products Laboratory; F. W. O'Neil, College of Forestry, New York State University; J. H. Heuer, Great Northern Paper Co.; S. R. Parsons and W. F. Foote, Consolidated Water Power & Paper Co.

facture. These were freeness, occasional burst tests and continual use of the blue gloss. A variety of means of refining groundwood screenings for use in board were presented. Some mills use the refined screenings only in the filler, while others use them in the back or even in the liner. There was a discussion of the trend in use of groundwood in board manufacture and it was felt that the situation of groundwood versus wastepaper depended upon the economic situation present at any one time. In a discussion of wood for grinding, it was mentioned by several mills that they had trouble from pitch when using green wood. One mill mentioned using aspen in the manufacture of folding grades. Sizing problems were reported when using green aspen by several mills.

H. W. Hillier, Scott Paper Co., presided over a session on groundwood for tissue and toweling. Panel members were: E. Johnston, Stevens & Thompson Co., Greenwich, N. Y.; C. Malcolm, E. B. Eddy Co., Hull, Que.; R. E. Kissel, Charmin Paper Mills, Green Bay, Wis.; H. Jacques, Vanity Fair Paper Mills, Plattsburg, N. Y. Three advantages of the use of groundwood in the manufacture of tissue and toweling were outlined as follows: provides a slow sheet and improves formation; secondly, it bulks up the sheet; thirdly, it reduces the cost of the furnish. One of the principal problems in the use of groundwood in tissue and toweling is that of brightness when unbleached groundwood is used. Bleached groundwood is used in higher quantities because of the brightness. Another advantage mentioned for groundwood is that it promotes adhesion control on the creping drier. Poplar groundwood is manufactured in the midwest. One of the problems discussed in the use of groundwood was that it tends, under certain conditions, to give a "brashness" to the sheet. Higher freeness of groundwood was reported to give less "brashness" in the sheet and it seems that there might be a place for this type of pulp in the tissue of the future. Another problem with the use of groundwood, particularly in toweling, is that of absorbency. It was stated that there are times when there is great variation in the absorbency of unbleached groundwood. Higher grinding temperatures were said to give softer pulp with less pitch trouble. There were two differences of opinion regarding the cleaning of groundwood; one point of view was that it was better to clean the groundwood in the pulp mill where you are dealing with one type of fiber only. The other school of thought was that the stock should be cleaned as close to the paper machine as possible in order to avoid contamination. It was suggested that hardwood groundwood gives more pitch trouble. The meeting discussed the various testing methods used in the control of groundwood for tissue and toweling. The following tests are used more or less regularly: freeness, burst, tear, absorbency, softness, and fiber classification. Another method suggested was the making of an extremely thin sheet of the pulp which, when dried and placed against a dark surface, give a very good idea of the nature of the individual fibers. Several of those present reported that bleached pulp caused more slime trouble. This was said to occur after the neutralization stage.

Refining Session

On Tuesday evening, a two-hour session was held on "Refining." T. G. Rust, Quebec North Shore Paper Co., was chairman.

"Low Consistency Refining of Groundwood Rejects at the Spruce Falls Power and Paper Co., Ltd." was the subject of a paper by E. Gardiner, groundwood mill superintendent, and R. Stafford, technical department project leader of that mill. This was presented by Mr. Stafford.

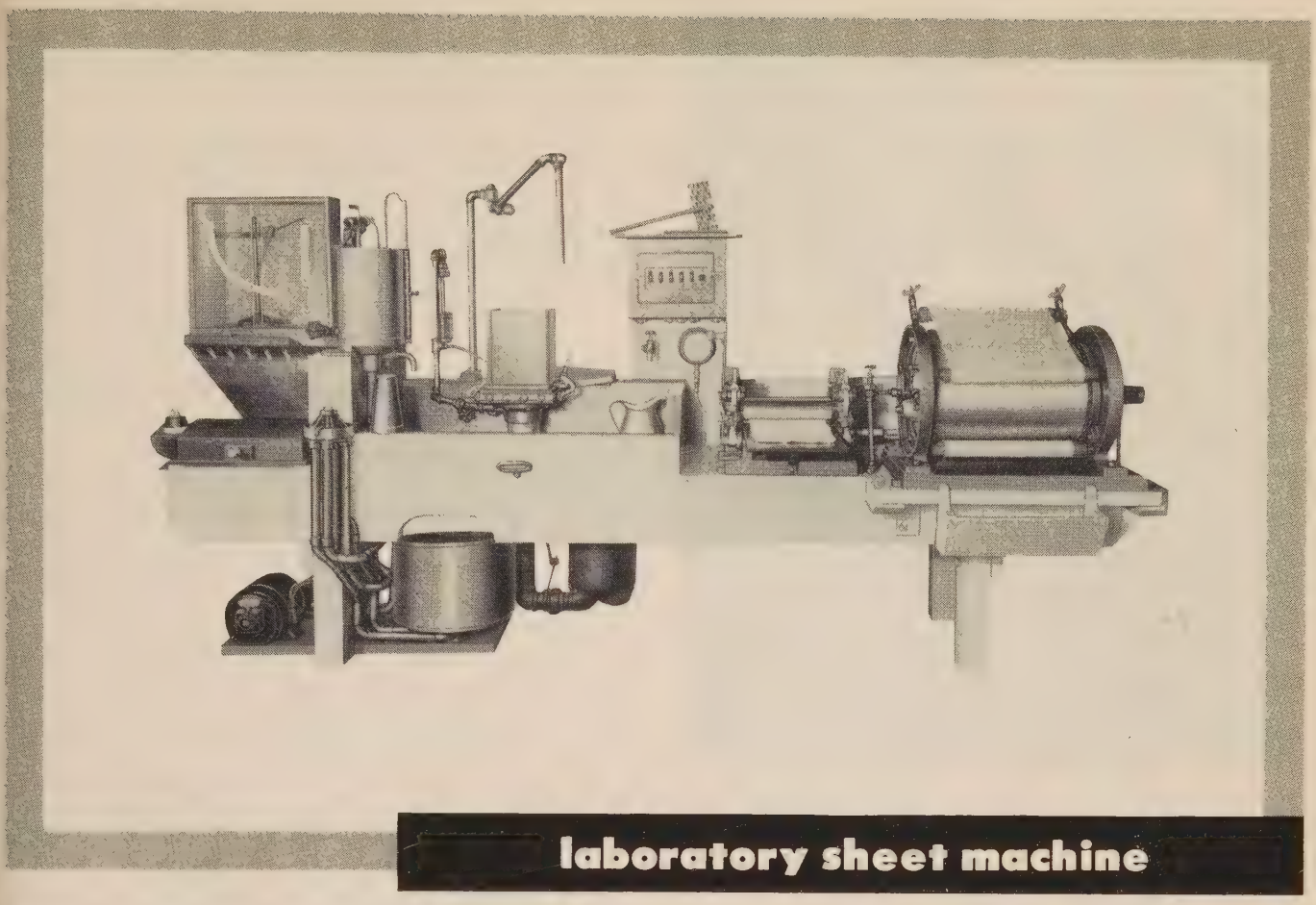
In this paper the authors outlined the advantages of refining of groundwood rejects at consistencies as low as 1% (air-dry), which has been a normal procedure at the Spruce Falls Power and Paper Company for several years, as compared with high consistency refining at 10 to 12% (air-dry).

These advantages are: (1) The refined stock quality has been much more uniform and considerably better with respect to reduction of silvers, fibrillation, and cleanliness. (2) The circulating load of tailings through the screening system has been greatly reduced and this has undoubtedly increased screening efficiency. (3) The refiners can be operated steadily at peak motor loads since there is very little fluctuation in load and, therefore, less tendency for momentary overloading. (4) The amount of supervision required at the refiners has been greatly reduced due to more uniform operations.

In this paper the authors also described the groundwood mill and paper mill systems of the Spruce Falls Power and Paper Co.

Mr. Stafford and Mr. Gardiner answered questions following their paper and this discussion brought out that more good quality stock can be made at low consistency than at high consistency.

Foreign Mill Representatives at the Mechanical Pulping Conference. Back row, left to right: P. Bersano, Cartiere Burgo, Torino Italy; K. Hoger M. Carlsson, Holmens Bruks Och Fabriks AB, Hallstavik, Sweden; John Somerville, Australian Newsprint Mills Ltd., Boyer, Tasmania; T. F. LaHaise, general chairman of Conference; W. Gruenewald, Feldmuehle, Dusseldorf, West Germany; Karl Schmidt, F. M. Voith Mfg. Co., Heidenheim, West Germany. Front row, left to right: E. H. Lenz, Loreto Y Pena Pobre, SA Obregon, D. F., Mexico; G. W. King, Bowaters Lloyds Pulp Paper Mills, Ltd., Sillingbourne, Kent, England; C. Anker, A/S Risor Traemassefabriker, Risor, Norway; George Thompson, Bowaters Paper Corp., Ltd., London, England; Otto Brauns, Central Laboratory of Mechanical Pulping Industry, Stockholm, Sweden



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G. C. Cole, Finch, Pruyn Co.; J. K. Kirkpatrick, Bowaters Southern Paper Co.; and J. L. Parsons, consultant

Otto Brauns, Stockholm, Sweden, spoke briefly on the approach of his laboratory to groundwood research, which he described as "at the crossroads." Mr. Brauns said that his laboratory is presently checking on equipment, grinders, and stones in an approach to the right road.

E. P. Walsh, control superintendent, Anglo-Canadian Pulp and Paper Mills, Ltd., Quebec, Que., presented a paper on "The Reisten Refiner."

Mr. Walsh discussed the trial installation of the first Reisten refiner at Anglo-Canadian Pulp and Paper Mills, Ltd., which was started up in September, 1953, for the recovery of groundwood fine screen tailings. This proved to be such a success that a year later it was followed by a refiner center consisting of four Reistens and related screening and thickening equipment.

The author said that this machine has three sets of disks, each set having a stationary and a rotating disk. The special features of this machine are slotted disks with abrasive tackle, slow speed of 190 r.p.m., and built-in recirculation of stock being treated. The refiner is well and heavily constructed, simple to operate, and easy to maintain.

Mr. Walsh said that the capacity of the machine is 10 tons of screened stock per 24 hours. Power consumption is 15 h.p. per ton at a freeness of 130 to 150 C.S.F. Pulp strength as determined by burst and tear tests is better than no. 1 groundwood. While paper machine operation improved following the refiner installation, Mr. Walsh said that it was felt that this was due to side effects that accompanied the refiner installation rather than the quality of Reisten stock. All experience indicates that Reisten stock has no adverse effect on paper quality or machine operation.

In a brief question period on the Reisten refiner, Mr. Walsh described the action of this equipment and the brushing and cutting. He said that with the slow speed used there is more cutting. His other responses were, that the whole construction of this refiner is cast iron; that the disks last a long time; that he is refining at about 2% consistency; that the wear on the disks is even; that the actual amount of stock recirculated can be controlled by cutting down the feed; that the ultimate output per 24 hours on one unit is 10 tons with 150 h.p. motor; and that this unit is now being used with four sets of disks with 200 h.p.

Wednesday, Sept. 21, 1955

On Wednesday morning there was a holdover Panel Session on the "Regional Aspects of the Production of Groundwood for Printing and Specialty Papers," and the discussion developed that for the best effect on the finished surface, the plates in the screening operation have to be fine enough; that the screening department is as important as the grinding department; that the pulp must be ground right and any irregular sized particles, shives, or dirt are most detrimental on a sheet to be coated; that screening is most important if the final result is to be satisfactory. The characteristics of the stock cannot be changed if the defects produced by the grinder are not properly screened.

There was a discussion on screening in the pulp mill versus screening in the paper mill and it was said that it is more economical to do most of the screening in the groundwood mill.

Newsprint Panel

A panel session on "Regional Aspects for the Production of Groundwood for Newsprint," was also held on Wednesday morning. J. M. Cairnie, Ontario Paper Co., was chairman and George Shipman, Donnacona Paper Co., moderator. The topics discussed were: influence of wood species, wood size, wood moisture content, grinding stone, and characteristics. Also, what species are under control, pitch trouble, and problems on the paper machine.

On species, an experiment with 10% eastern white pine showed little pitch trouble, but in a run on 100% of this species much pitch trouble developed. There was another report on the use of eastern white pine in hanging paper in which pitch trouble developed, but was overcome with sizing and agents. It was found that the greater the age of the wood, the less pitch trouble. Then followed a lengthy discussion on pitch control with alum in several wood species

F. W. O'Neil, College of Forestry, State University of New York; and T. G. Rust, Quebec North Shore Paper Co.

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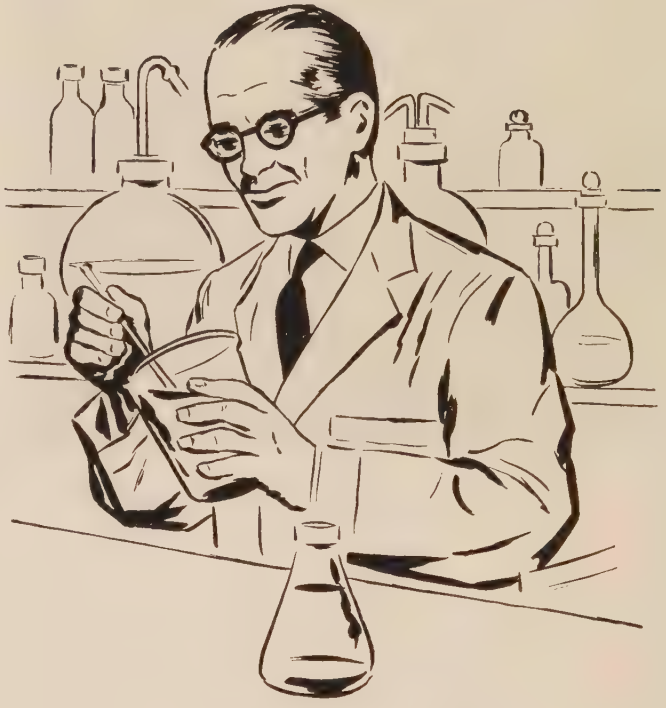

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W. H. de Montmorency, Pulp & Paper Research Institute of Canada, T. F. LaHaise, Imperial Paper & Color Corp.; and J. H. White, Keyes Fibre Co.

It was brought out that there is a definite trend toward the widening of grinders to handle 60 and 64-in. wood, especially in the new mills in the south and northwest.

On the effect of moisture content of the wood at the grinder, it was stated that a 40% content is considered good, although most river driven wood runs 50%. In the south the wood runs 50% moisture content even though no river transportation is involved.

It was said that in pulpstones a trend is developing toward sharp and single-grit stones because they tend to eliminate variables in the fibers. There is a definite trend to 30 to 60 single grit stones in the south and a little coarser grit in the north; 60 to 70 grit where printing groundwood papers are concerned.

In a discussion on "brightening," a report was made on the use of zinc hydrosulphite on news although caution was advised because of the corrosion problem unless the mill is equipped with an elaborate washing system. It was also suggested that the vacuum system for grinder exhausts also helps brightening.

Cleaning and Bleaching Session

On Wednesday afternoon there was a symposium on "Cleaning and Bleaching," with J. L. Parsons, consultant, Waterville, Me., chairman. "The Use of Bauer Cleaners in the Groundwood Mill," was discussed by T. G. Shepherd, Donnacona Paper Co., who reported on an investigation to determine the capacity, dirt removing efficiency, and per cent of rejects on a groundwood primary screen and accepted stock on Centri-Cleaners. The result of the test showed that the dirt removing efficiency increased with increased inlet pressure.

"The Use of Dirtecs in the Groundwood Mill" was the subject of the next paper by J. J. Moynihan and J. K. Kirkpatrick, Bowaters Southern Paper Corp. This was presented by Mr. Moynihan. In this paper the authors gave a report of actual mill operating conditions and pointed out that it was "not one of controversy to bring up the eventual argument of merits of the various named pressure-drop cleaners on the market for use by pulp and paper makers. This paper is in no way a sales promotion for the equipment described. All mills, regardless of similarity of end product manufactured, operate under different conditions thus allowing each operator to his own desire in both purchase and point of installation of these cleaners."

The authors pointed out that they have Dirtecs as their pressure-drop cleaners at the Bowaters Southern Paper Corp. and they are used on groundwood exclusively. The authors feel that a stock system such as they have offers a greater chance for dirt and grit removal from the principal newsprint furnish than one in which the cleaner battery had been installed closer to the paper machines.

Operating evidence at Bowaters shows that the Dirtecs are doing a good job with respect to dirt and grit removal in the stock system. The authors said this was confirmed by the fact that they have not lost a wire from either paper machine due to grit abrasion since the mill started operating, nor has the paper mill group been able to find any tell-tale evidence of grit carry-over to the machine.

In conclusion, the authors said that test results on inlet and outlet stock from the Dirtecs show a removal of approximately 80% of the foreign material contained in the original stock.

Then followed a panel discussion with Mr. Parsons as moderator. The panel was composed of: G. C. Cole, Finch, Pruyn Co., Inc., J. K. Kirkpatrick, J. Moynihan, and T. G. Shepherd.

Mr. Cole reported briefly on the cleaners in his mill and said they are doing a great job in eliminating shives and other objectional matter, and the sheet is now clean to the eye.

There was discussion on the pumping cost on a refiner, and it was stated that the cost is higher at the lower consistencies.

Then followed a session on bleaching.

Frank A. Whitman, special projects engineer, Hollings-

A. E. Jones, Oxford Paper Co.; Jack F. Wright, National Aniline Div.; H. E. Pratt, Pejepscot Paper Div.

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worth & Whitney Division of Scott Paper Co., presented a paper on "The Effect of Pulpwood Aging on Groundwood Brightness."

Mr. Whitman outlined the tests made at his mill to determine the influence of the storage time of freshly cut pulpwood on the brightness of the unbleached and bleached groundwood. Tests were carried out on groundwood made from local freshly cut spruce and balsam fir woods, and from similar samples after storage for 3, 6, 9, and 12 months, in the unbarked and barked condition.

The results of these tests, according to Mr. Whitman, were as follows:

1. The season that the wood was cut appeared to have little, if any, effect on the wood in storage, or the resulting groundwood.
2. There was no substantial difference in the bleachability of fir or spruce groundwood made from freshly cut wood.
3. Barking of pulpwood before storage lowered the aging rate of the wood, and thus yielded unbleached and bleached groundwood of higher brightness.
4. The relationship between pulpwood storage time and groundwood brightness drop was a straight line relationship dependent on the initial brightness of the freshly cut wood. This was true of both fir and spruce.
5. The same brightness gain with bleach was obtained whether the pulpwood was freshly cut or aged 12 months before grinding.
6. It was possible to obtain the same brightness gain with 0.5% sodium peroxide if the pulpwood was freshly cut or aged the same length of time before grinding. If 1.0% zinc hydrosulphite or 1% sodium peroxide was used as the bleaching agent, this was not true. The zinc hydrosulphite gave the greater brightness increase.
7. The economical advantage of using freshly cut spruce or fir wood for the production of bleached groundwood was clearly demonstrated because the saving in bleaching chemicals is substantial if wood used for grinding is less than 6 months old from the time it is cut.

"Groundwood Bleaching at St. Regis Paper Co., Bucksport, Me.," was the title of the next paper, by H. J. Bayer, assistant pulp superintendent. After reviewing the rapid expansion of the bleaching of groundwood with peroxides following installation of the first commercial peroxide groundwood bleaching in the industry at the Norfolk, N. Y., mill of St. Regis, 1941, Mr. Bayer also referred to the establishment of the first mixed pulp peroxide bleachery in the industry at Bucksport in 1947. In 1954 an independent peroxide bleachery was started up for bleaching sulphite alone and the old system was

The TAPPI group which visited the Great Northern Paper Co.

converted for groundwood bleaching, the independent systems making the entire bleaching process more flexible. Mr. Bayer then described the bleached liquor preparation and the bleaching process. He also went into the bleaching theory, bleaching results, the cost of bleaching, and the advantages of peroxide bleached groundwood. Mr. Bayer said that, generally speaking, the cost of peroxide bleaching of groundwood will vary between $9.00 and $15 per ton, depending upon the ultimate brightness level required and the bleach plant's operating capacity. He said the advantages derived from the peroxide bleaching of groundwood are increased brightness, improved sheet formation, improved drainage on the wire, dirt removal, increased softness, and less loss of brightness over the driers. The disadvantages appear to be a decrease in opacity and increased cost over unbleached groundwood.

D. B. Sparrow, Scott Paper Co., presented a paper on "Bleaching Groundwood with Hydrosulphite." Mr. Sparrow said that while hydrosulphite has been used for many years in the textile industry as a reducing agent in vat drying and as a stripping agent, it was not used extensively in bleaching groundwood until recently. The variable and unpredictable results obtained in its application to groundwood was one of the major causes for its limited use as a bleaching agent.

Mr. Sparrow said that in work done at Scott Paper Co. leading to the commercial application of hydrosulphite bleaching, the effect of metal deactivators as well as the many other variables in the process were investigated. As the result of this investigation, a novel bleach plant was designed utilizing pulp directly from the grinders. In addition, Mr. Sparrow said, since the bleached pulp was to stand in storage for periods of 3 months, or longer, in bale form at 60% consistency, a method was developed for control of brightness reversion in wet, hydrosulphite bleached groundwood.

Mr. Sparrow outlined in detail and in table form the work done in the laboratory, as well as the operation of the novel bleach plant.

C. A. Richardson, Blandin Paper Co., Grand Rapids, Minn. presented a paper on "Multistage Bleaching of Groundwood."

In his paper Mr. Richardson give the results of a series of laboratory experiments performed using zinc and sodium hydrosulphites as a single-stage bleach, sodium hydrosulphite as a pretreatment to peroxide, and sodium hydrosulphite as both pre and post-treatment to peroxide. It was found that sodium and zinc hydrosulphites in conjunction with sodium tripolyphosphate can be used

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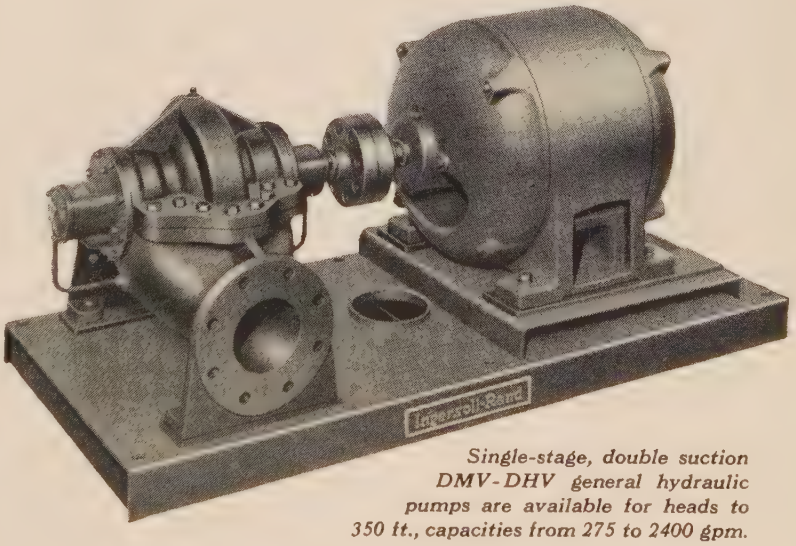

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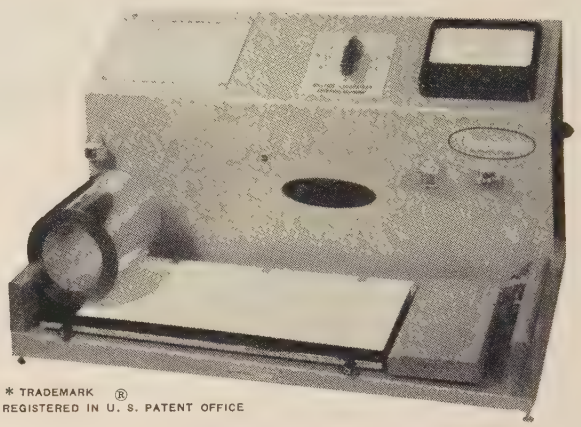

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to bleach groundwood pulps, and to give a super-bleach to peroxide bleached pulp. The sodium hydrosulphite gave somewhat better results than the zinc.

A. A. Yankowski, research and development, Kimberly-Clark Corp., Neenah, Wis., gave a "Summary of Groundwood Bleaching Methods" in which he gave the names of the various bleaching chemicals, percentage effect of the chemical, effect of consistency and temperature, pH and alkalinity, gains in brightness, cost of chemical, and the cost per point per ton depending upon wood and brightness desired.

A panel discussion composed of the following members followed the presentation of the papers at this final session: R. C. Osborn, Finch Pruyn Paper Co., Herman Bayer, St. Regis Paper Co., Bucksport, Me., and Messrs. Richardson, Sparrow, Whitman, and Yankowski.

In their closing remarks on the entire conference program, Co-Chairmen W. H. de Montmorency, and J. H. White both congratulated and thanked the committees which staged the conference, the speakers and moderators, the members of the technical associations represented here, and the mill managements who sent their personnel to this meeting. They expressed the hope that all had benefited greatly from the splendid program of the sessions and panels.

Banquet

The official banquet of the conference was held on Monday evening, September 19. T. F. LaHaise, general conference chairman, was toastmaster. After introducing the members of the conference committee and their wives, Mr. LaHaise called on Miss Marion Martin, Secretary of Labor and Industry for the State of Maine who welcomed the delegates on behalf of the State.

K. O. Elderkin, vice-president and general manager of Bowaters Southern Paper Corp. and president of TAPPI, greeted the delegates on behalf of national TAPPI, and J. G. Penny, manager, Bowaters Newfoundland Pulp and Paper Mills and a member of the council of the Technical Section, Canadian Pulp and Paper Association, spoke on behalf of the latter organization.

R. G. Macdonald, secretary-treasurer of TAPPI, introduced the guest speaker, James L. Ritchie, executive director, U. S. Pulp Producers Association, who delivered an address on "The Groundwood Economy." The full text of Mr. Ritchie's remarks was published in the October issue of *Tappi*. Mr. Ritchie was thanked on behalf of the delegates by Douglas Jones, executive secretary, Technical Section, Canadian Pulp and Paper Association.

Ladies' Program

The ladies' program, under the direction of Mrs. T. F. LaHaise, chairman, featured a bridge and canasta party and tea on Monday, September 19; Tuesday, September 20, putting contest on the green and a style show in which Mary Davis presented her original designs; Wednesday, September 21, a visit to the TV studio in Ricker House and a trip to the Bates Manufacturing Co., Lewiston, Me.

Exhibits

Throughout the conference the following companies exhibited a variety of products made partly or entirely of mechanical pulp:

Coosa River Newsprint Co., Coosa Pines, Ala., rolls of southern newsprint; J. P. Lewis Co., Beaver Falls, N. Y., note paper, Satinkote railroad board, milk bottle caps, and gaskets; Keyes Fibre Co., Waterville, Me., egg container, dinner and luncheon plates; Blandy Paper Co., Schuylerville, N. Y., lightweight pulp board; Oswego Falls Corp., Fulton, N. Y., Sealright sanitary food containers; St. Croix Paper Co., Woodland, Me., newsprint roll; Diamond Match Co., Ogdensburg, N. Y., paper plates and cups; Scott Paper Co., H. & W. Div., Waterville, Me., sample of no. 1, regular

groundwood, Scott towels, tissues, waxpaper, napkins; Imperial Paper and Color Corp., Plattsburg, N. Y., washable wallpapers. Also on display were rolls of Canadian colored newsprint.

Foster H. Fulton, Consolidated Paper Corp., Shawinigan Falls, Que., was in charge of the product display.

Mill Visits

Many of the delegates made trips of inspection on Thursday, September 22, to the following nearby mills: Great Northern Paper Co., East Millinocket, Me.; International Paper Co., Chisholm Me.; Keyes Fibre Co., Groundwood Mill, Shawmut, Me.; Oxford Paper Co., Rumford, Me.; Pejepscot Paper Co., Brunswick, Me.; and St. Regis Paper Co., Bucksport, Me.

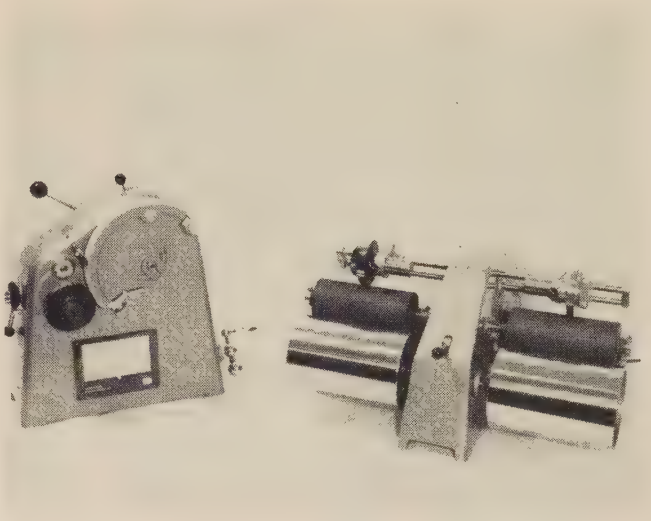
Precision of TAPPI Testing Methods

The Testing Division has had under consideration for some time the advisability of starting a project to determine the precision of all TAPPI Standard Methods. Last December, a questionnaire was sent out to all members of TAPPI, asking if they had data available on precision testing, and also if they would be willing to take part in round-robin testing to determine precision.

Approximately two hundred replies were received on this questionnaire. Seventy-seven people stated they had information already available, while 147 people stated they were willing to take part in round-robin testing.

A second questionnaire has now been sent to these people, and the replies are being compiled. Anyone who did not receive this second questionnaire and has precision data to submit, or wishes to take part in round-robin testing, should write to TAPPI headquarters and a copy of the questionnaire will be sent to them.

The TAPPI Committee on Precision Testing met at the Testing Conference in Springfield to outline the preliminary steps to be taken. Before the February convention, it is planned to make a literature survey to determine the present information available, and also to study any reports on precision which can be supplied to the committee immediately. Plans for future work will be made after this preliminary report is studied. It is hoped that eventually a statistically sound statement of precision can be added to every TAPPI Standard Method.



"New developments, faster machines, higher quality standards, call for greater uniformity of quality, call for more and more effective control of quality. Before one can control, one must first be able to measure."

This was the slogan under which the **SIXTH TAPPI TESTING Conference** was organized and where **the I.G.T. PRINTABILITY TESTER** turned out to be the **TOPIC OF THE DAY.**

For a condensed description and a listing of the main features,
PLEASE TURN TO.....Page 143 A of this issue

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Seventh Coating Conference

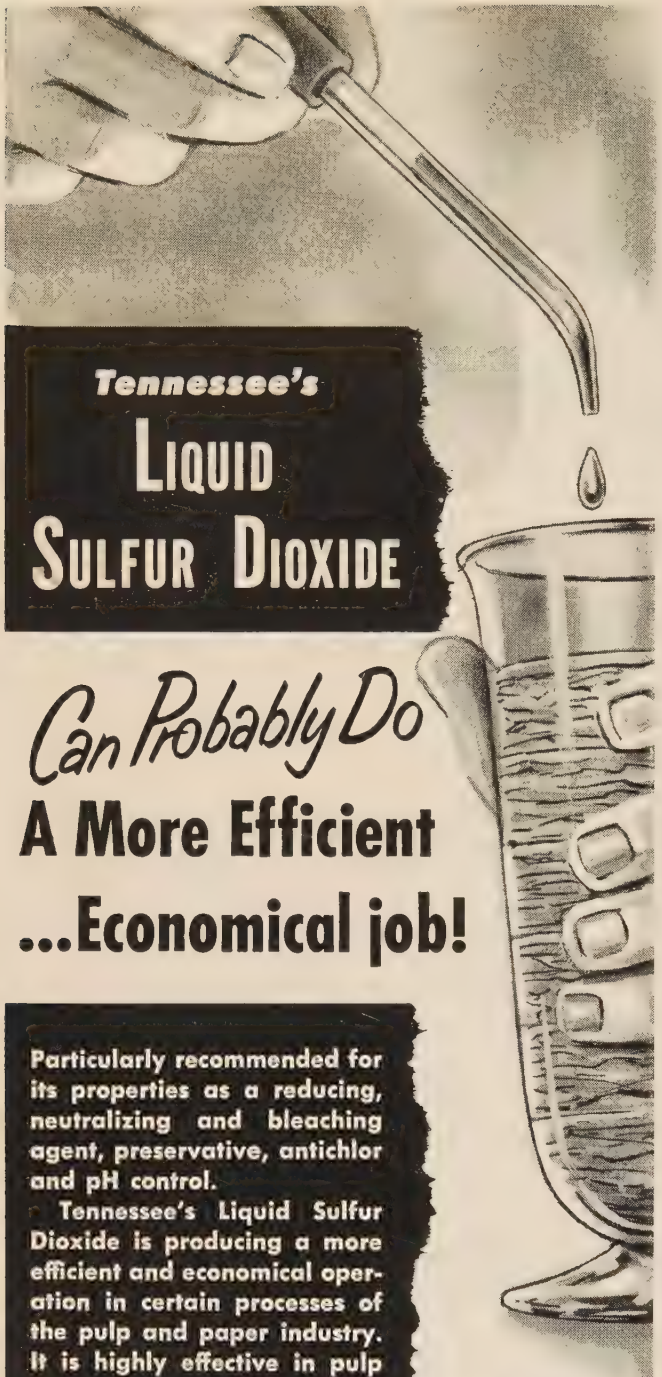
Plans for the Seventh TAPPI Coating Conference to be held in Philadelphia in May, 1956, are taking shape and the Program Committee promises an agenda of interesting and widely varied subjects relating to synthetic adhesives for coating.

The city of Philadelphia provides an excellent background for the conference because of the large number of paper plants and allied industries in its environs. However, the rich historical background of the city will be an extra attraction to the papermakers and their families. It was here that the Declaration of Independence was signed on July 4, 1776, in Independence Hall. The First and Second Continental Congress met in Philadelphia, and the city was the national capital from 1790 to 1800. The signing of the Constitution of the United States also took place in Independence Hall.

Through the medium of paper, these events—so important in the lives of all Americans—are preserved for us to see and enjoy today.

Sixth Testing Conference

The Sixth Testing Conference of the Technical Association of the Pulp and Paper Industry was held at the Sheraton-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Kimball Hotel, Springfield, Mass., Sept. 28 to 30, 1955. J. P. Casey, A. E. Staley Co., Decatur, Ill., is general chairman of the sponsoring Testing Division of TAPPI. The general chairman of the conference was Paul W. Bartholomew, Minnesota and Ontario Paper Co., International Falls, Minn.

Mr. Bartholomew was assisted by the following committee: R. H. Simmons, Program, U. S. Government Printing Office, Washington, D. C., W. Schoenberg, Publicity and Exhibits, Lord and Schoenberg, Cleveland, Ohio, and R. W. Ramsdell, Local Arrangements, Hercules Powder Co., Holyoke, Mass.

Assisting Mr. Ramsdell with the local arrangements for the conference were R. Mallock, Exhibits, American Writing Paper Corp., Holyoke, Mass., and C. L. Reece, Registration, Westfield River Paper Co., Russell, Mass.

The attendance at the conference totalled 288 delegates, from all parts of the United States and Canada. The various committees of the testing division held all day meetings on September 28, and the conference also included four technical sessions, as well as exhibits of pulp and paper testing instruments, and visits to local mills. A highlight of the meeting was the official banquet on Thursday evening, when the delegates were addressed by A. E. Bachmann, Missisquoi Corp., Sheldon Springs, Vt. Papers are included in the account given below. The full text of the papers will be published in subsequent issues of *Tappi*. Reports of the committee meetings are to be found in the Divisions and Committees Section of this and later issues.

Technical Sessions

On Wednesday, September 28, a brief opening session was held under the chairmanship of J. P. Casey, A. E. Staley Mfg. Co., Decatur, Ill. After welcoming the delegates to the conference, Mr. Casey introduced E. E. Stephenson, Sutherland Paper Co., Kalamazoo, Mich., who discussed the Routine Control Methods, and the new committee that has been organized to prepare and process them. Mr. Stephenson discussed the various ways in which the RC methods are used, and emphasized the difference in scope between the Routine Control Methods Committee, and the Process Instrumentation and Control Committee of TAPPI. Stressing that the obtaining of new routine control methods was largely in the hands of the entire membership of TAPPI, the speaker suggested the following criteria for proposed methods:

1. A Routine Control method must yield information of use in controlling the manufacture or conversion of paper or paper-

Group picture of Testing Division chairmen and Steering Committee. Seated, l. to r.: R. H. Simmons, E. E. Stephenson, Wm. Schoenberg, A. J. Winchester, J. P. Casey, L. V. Hans. Standing, l. to r.: C. E. Brandon, P. W. Bartholomew

board by giving information concerning the process itself or concerning raw materials used in that process.

2. A Routine Control method must be comparatively rapid so that the information may be used to control plant operations.

3. A Routine Control method must be comparatively simple so that nontechnically trained personnel may be used in routine performance of the test.

4. A Routine Control method must involve an agent as opposed to the integrated operation of process instrumentation or control instrumentation.

The second paper of the Wednesday morning session, entitled "Statistical Studies of Rosin Sizing, Evaluation Variables II. The Use of Variance Analysis for Rosin Sizing," was presented by W. M. Wooding, American Cyanamid Co., Stamford, Conn. Mr. Wooding described work which has been done in the Stamford laboratories of American Cyanamid Co., in applying the principles of analysis of variance to the study of sizing data. The most effective use of statistical techniques has been found to result from their use by the experimenter himself, with the guidance of a professional statistical staff, if possible. This approach ensures proper design of the experimental work and a fuller understanding of both the experimental phases and the statistical interpretations than would be achieved by the presentation of completed experimental data to the statistician for analysis. Furthermore, such a statistical approach by the experimenter himself allows a much greater objectivity than would otherwise be possible.

Mr. Wooding presented the basis of the variance analysis technique; examples of its use; special approaches necessary when paper sizing data are the subject of the analyses, and an appendix containing standard formulas for use with the technique.

Thursday Sept. 28, 1955

On Thursday morning, September 20, a paper testing symposium was held under the chairmanship of L. Price, U. S. Government Printing Office, Washington, D. C. The first paper was entitled "Relation between Surface Hardness and Blocking Temperature for Paraffin Waxes," by K. G. Arabian, S. Marple, Jr., and G. P. Hinds, Jr., Shell Oil Co., Houston, Tex. The authors described a method of estimating the blocking temperature of paraffin waxes without applying the wax to paper. Encouraging results have been obtained by using the Durometer to measure a property called "surface hardness," which permits estimating the blocking temperatures of some paraffin waxes within 2°F.

By determining surface hardness at several temperatures

P. Bartholomew, R. W. Ramsdell, Wm. Schoenberg, R. H. Simmons, R. Malloch, C. L. Reece: Sixth Testing Conference Committee

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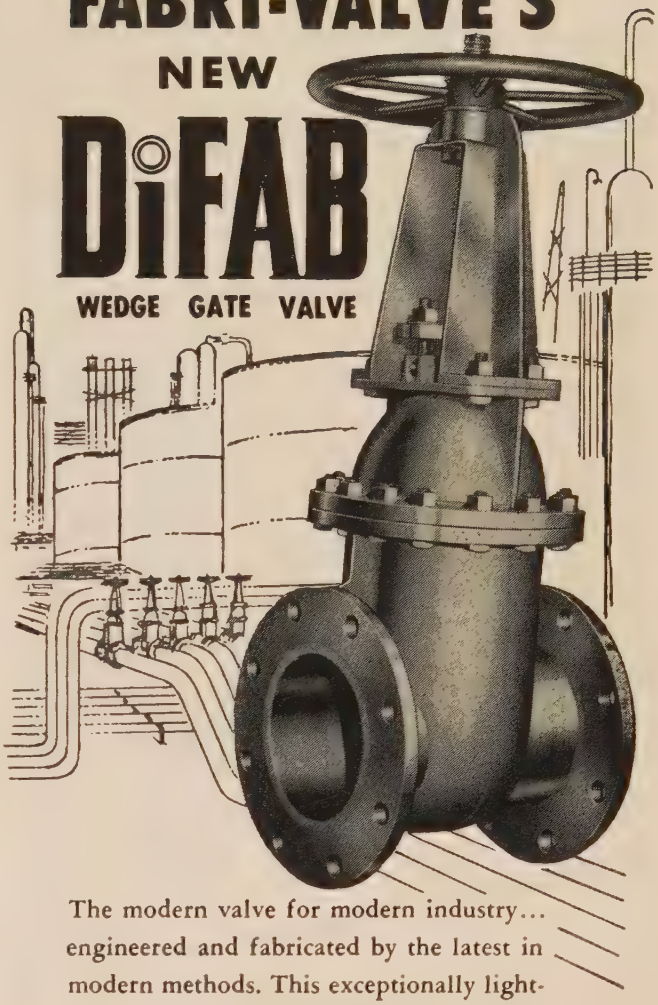

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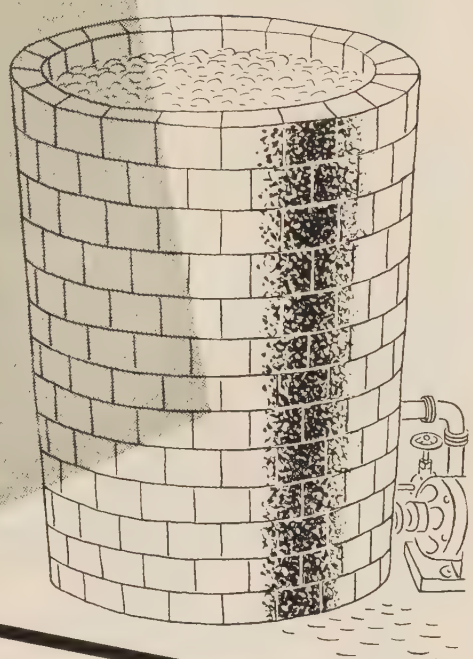

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- "Treatment of Raw and Waste Waters with PQ Silicates"... Bulletin No. 52-19
- "Stixso Adhesive Processes for Quality Corrugated Paper Board"... Bulletin No. 12-21

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between 70 and 150°F., it was found that the temperature at which waxes exhibit a hardness of 40 kg. per sq. cm. corresponds within 2°F. with the blocking temperature of these waxes. This was true for 18 of the 21 waxes used in the study. For the other three waxes the blocking temperatures estimated by hardness measurements differ by three to six degrees from the actual blocking temperatures.

Commercially prepared paraffin waxes from several crudes were used in the study and the actual blocking temperatures were determined by both the Kalamazoo Vegetable Parchment and the gradient block methods.

The relation between the temperature at which a wax has a hardness of 40 kg. per sq. cm. and its blocking temperature was dependable for blends containing paraffin wax and plastic microcrystalline wax up to concentrations of 40% microcrystalline wax. At higher concentrations of the microcrystalline wax the blends blocked at temperatures corresponding to higher hardness (50 to 60 kg. per sq. cm.). There are very limited data in this study (four samples) which indicate that the relation can be used for blends containing up to 5% polyethylene.

The authors stated that further studies are desirable to determine the extent to which this technique can be used as a general means of estimating the blocking temperature of waxes.

G. E. Murray presented the second paper of the Thursday morning session, entitled "Grease Resistant Papers I. A Pinhole Test for Coated Papers," by J. Van Horn, G. E. Murray, and L. V. Hans, Quartermaster Research and Development Center, U. S. Army, Natick, Mass. Mr. Murray described the development of a rapid, nondestructive method for determining the number and size of holes in organic film coated papers.

The method, based on the pin-hole test used for paint films, consists of placing the coated paper in contact with a wet electrolyte containing paper between two steel plates and passing an electric current through the plates. Iron is electrolytically transported through any holes in the film into the electrolyte paper and on immersion in ferrocyanide solution dark blue spots of ferric ferrocyanide appear wherever imperfections existed. Preliminary tests show that coated papers containing numerous pin-holes are penetrated rapidly by grease whereas those that show no pin-holes are extremely resistant to grease penetration. Papers that have only a few pin-holes give erratic results in that most samples tested are highly resistant to penetration, while an occasional sample is penetrated rapidly. The authors suggested that this procedure may be-

Group picture of General Session held at Tecnifax Corp. during the Sixth Testing Conference. Persons in front row, l. to r.: D. P. Habib, Tecnifax Corp.; I. H. Isenberg, Institute of Paper Chemistry; F. L. Simons, Crane & Co., Inc.

come a valuable accessory test in the evaluation of organic film coated grease resistant papers.

"Rate of Moisture Gain or Loss in Kraft Paper and Board" was the title of the third paper, by J. S. Moore, Union Bag & Paper Corp., Savannah, Ga. Mr. Moore's paper was presented by G. C. Kimble of Union Bag. The paper described a new, simple method for measuring the rate of gain or loss of moisture in paper and board samples. The purpose of the work was to determine the conditioning time necessary for paper and board to reach an acceptable moisture content for testing. Also to determine the rate at which paper and board gain or lose moisture when converted or used under extremely damp or dry conditions.

Four general conclusions were drawn from the data presented.

1. Heavier papers condition slower than lighter weights. Some heavier boards appear not to reach equilibrium even after 24 hours exposure if the original moisture content is considerably different from the equilibrium level.

2. For papers below 80 lb. basis weight, exposure for about 15 minutes at 73°F. and 50% R.H. should be sufficient for most control testing if good air circulation is assured. Care should be taken to have the sample below 6% moisture content before placing it in the conditioning atmosphere. Fifteen minutes preconditioning at 35% R.H. should be enough even though TAPPI specifies more drastic preconditioning.

3. Moisture content changes rapidly when paper or board of normal moisture content is first exposed to extremely dry or damp atmospheres. However, the exposure time on most converting machinery is too short for relative humidity at the point of conversion to have much effect on moisture content or strength.

4. In most end uses, paper and board will be exposed for a long enough time for relative humidity to have a marked effect on the moisture content, and therefore on the strength.

Ralph Green, Thwing-Albert Instrument Co., Philadelphia, Pa., presented the next paper, "The Handle-O-Meter and Quality Control in Testing Tissue." Mr. Green stated that since "feel" is a composite of many other qualities, its measurement represented a complex problem. The author presented the basic requirements for a successful test instrument, and gave a summary of experience in seven mills using the Handle-O-Meter. The sum of these collective experiences indicates that in the field of tissue manufacture, an instrument is now available that measures a heretofore intangible quality.

Testing Committee Chairmen: I. H. Isenberg, The Institute of Paper Chemistry; D. N. Obenshain, West Virginia Pulp & Paper Co.; T. E. Dobbins, American Can Co.; F. E. Caskey, Morden Machines Co.; L. Price, U. S. Government Printing Office; A. R. Ewing, Bemis Bros. Bag Co.; E. E. Stephenson, Sutherland Paper Co.; E. K. Williams, Midwest Gummed Paper Co.

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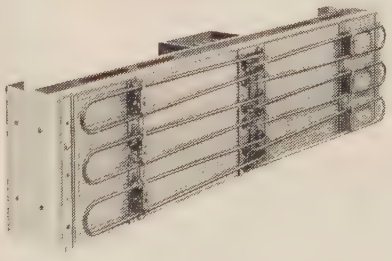

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The final paper of the Thursday morning session, "Mill Brightness Control. Experience with Instruments Not Conforming to TAPPI Standard T 452 m-48," by Richard G. Clark and Wm. H. Aiken, The Gardner Board and Carton Co., Middletown, Ohio, was presented by Mr. Clark. The authors described a study during which 28 Photovolt Reflection Meters Model 610, located in 19 board mills, were compared on 14 samples of board of varying brightness and texture. Large deviations were found between readings of these units and G.E. brightness. Very large variations were also found between the various Photovolt units.

Factors contributing to lack of agreement between Photovolt reading and G.E. brightness were explored. Major contributing factors appear to be lack of linearity of response of the instrument with light intensity, grain effect, and change of instrument characteristics with time. The authors discussed the use of the Photovolt Reflection Meter as an instrument for mill brightness control through use of the special calibration technique suggested by Dearth, Shillcox, and Van den Akker.

Three new Welch Densichrons were found to not give identical results when used for reflection determinations. Checks on the 14 samples with these three instruments showed closer agreement with the G.E. brightness and between themselves than were obtained with most of the Photovolt units. Mr. Clark discussed factors affecting deviation in the Densichron units and deviation of Densichron reading from G.E. brightness.

The authors also described experience in using the Densichron as a mill brightness control instrument using the special calibration technique.

On Thursday afternoon, September 28, the paper testing symposium was continued under the charimanship of E. E. Stephenson, Sutherland Paper Co., Kalamazoo, Mich.

T. W. Lashof, National Bureau of Standards, Washington D. C., presented a paper entitled "Paper Smoothness Testers," describing studies of the Bekk and Sheffield paper smoothness testers. Mr. Lashof compared the performance of the two instruments, using the Mandel-Stiehler sensitivity criterion and investigated the effect of the relative humidity of the compressed air supply for the Sheffield tester.

The second paper of the Thursday afternoon session, entitled "The Determination of the Permeability Constant of Gases and Vapors by High Vacuum Technique," by John A. Meyer, V. T. Stannett and M. Szwarc, College of Forestry, State University of New York, Syracuse, N. Y., was presented by Mr. Stannett. The authors described an apparatus which has been developed at Syracuse for measuring the transmission of gases through polymer films and resin treated

Speakers at the Paper Testing Symposium

papers under high vacuum. The equipment consists of a gas supply, a stainless steel cell holding the film or paper sheet in a fixed position, and a McLeod gage used for measuring the increase in pressure. Before starting a measurement, the membrane is completely degassed by pumping down to a pressure of 10^{-5} mm. of mercury. The time for degassing depends upon the nature of the membrane. A supply of gas, near or below atmospheric pressure, is then admitted to the top of the cell and the final supply pressure measured by means of a manometer.

The gradual increase in pressure on the low pressure side of the cell is measured at appropriate time intervals by means of a McLeod gage.

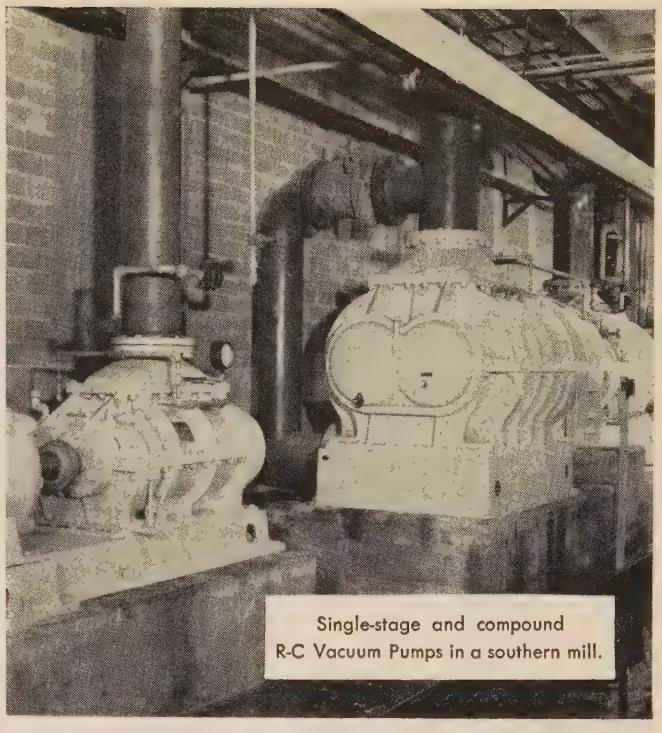
After the steady state has been reached the permeability constant can be calculated.

"The Aging of Heat Sealed Papers" was the title of the next paper by D. O'Brien, G. E. Murray, and L. V. Hans, Quartermaster Research and Development Center, U. S. Army, Natick, Mass. The paper was presented by Miss Hans, who described an evaluation of the again characteristic of heat sealed packets of kraft, foil, and kraft-backed foil papers. The results showed that after one year aging, the average strength of the seals had increased slightly in four of the five materials investigated while the fifth sample retained its original strength. Statistical analysis of one set of samples indicated that the strength increase was significant mathematically but not of practical importance. One week later, tests at −40°F., at +140°F., and +100°F., at 95% R.H. caused no deterioration of the seals. Wide variance in strength of seal were observed with foil packets from different companies, which was believed to be due partly to differences in design of the sealer jaws and partially to sealing temperatures. Sealing tests on 11 coated papers showed that a minimum temperature was necessary for proper sealing, that good sealing was obtained over a range of approximately 100°F., and that at higher temperatures somewhat poorer seals were obtained.

The following paper, by J. L. Harvey and B. W. Forshee, National Bureau of Standards, Washington, D. C., was entitled "The Determination of Starch in Paper." The authors described an evaluation of three methods for determining starch in paper, namely, the present TAPPI Standard (T 419 m-45), the maltase enzymatic method of Brobst and Langlois, *Tappi* 34: 38 (May, 1951) and the colorimetric method of Browning, Bublitz, and Baker, *Tappi* 35: 418 (September, 1952).

It was found that considerable quantities of materials ca-

At the Testing Conference dinner head table: R. W. Ramsdell, Hercules Powder Co.; R. H. Simmons, U. S. Government Printing Office; A. J. Winchester, TAPPI; A. E. Bachmann, Missisquoi Corp.; P. W. Bartholomew, Minnesota & Ontario Paper Co.; Miss Helen U. Kiely, American Writing Paper Corp.; and J. P. Casey, A. E. Staley Mfg. Co.



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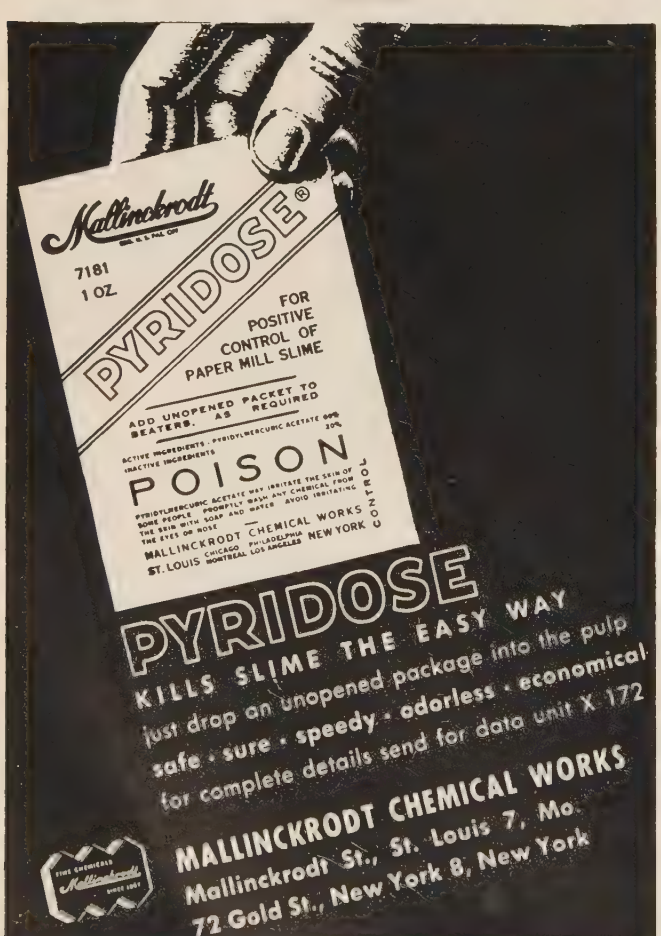
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pable of reducing Fehling's solution are removed from many pulps by water extraction alone. For the 15 chemical wood pulps and rag halfstocks examined, water extractable reducing material ranging from 0.04% equivalent starch for a bleached linen halfstock to 1.12% equivalent starch for a bleached hardwood soda pulp was found. Using an enzyme, even larger quantities are extracted. The extractable reducing material in the bleached coniferous sulphite pulps examined ranged from 0.29% to 1.08% as starch. As there appears to be no means of correcting for or eliminating this interference, methods based on the reducing value of the extract would seem to be less desirable than a colorimetric analysis based on the formation of the starch-iodide complex, since the latter reaction is highly specific. Extractables from materials normally expected in paper would not be expected to interfere with a colorimetric determination based on this reaction.

The authors reported study of the colorimetric method. The method of Browning, Bublitz, and Baker is generally satisfactory, but several slight changes were suggested. The chief limitation in accuracy is the differences in color produced by various types of starches. Consideration must be given to these color differences. It is also necessary to control time, temperature, and acid concentration during the extraction. Maximum absorption for all starches occurs in the neighborhood of 580 mmu. At this wavelength, Beer's Law applies for starch concentrations between 0 and 100 micrograms per ml. The author recommended that the colorimetric method be adopted as the TAPPI Standard.

The next paper, entitled "A Study of Paper Composition by Parallel Sectioning," by B. L. Browning and I. H. Isenberg, Institute of Paper Chemistry, Appleton, Wis., was presented by Mr. Isenberg. The authors commented on the desirability of knowing the distribution of size, filler, and other components through the thickness of the sheet in many technical problems concerned with paper structures and properties. Similar questions also arise in studies of the penetration of coatings and tub sizings into the base sheet. For several years the Institute laboratories have used a method based on parallel sectioning of the paper, followed by analysis of the prepared sections using suitable microtechniques. Mr. Isenberg described typical applications of this technique.

Friday Sept. 30, 1955

The final session of the conference was held in the auditorium of Tecnifax Corp., Holyoke, Mass., under the chairmanship of R. H. Simmons, United States Printing Office, Washington, D. C.

David P. Habib of Tecnifax Corp. welcomed the delegates to his plant, and presented a discussion of the problems involved in the testing of the various duplicating papers manufactured by Tecnifax.

R. H. Simmons, C. E. Brandon, Helen U. Kiely, A. J. Winchester, and P. W. Bartholomew

Following Mr. Habib's talk, the delegates were conducted on a tour of the Tecnifax plant, where they had an opportunity to observe the coating of Ozalid papers and the many specialized tests used in process control of Tecnifax products.

Following luncheon at the Rogers Smith Hotel in Holyoke, the delegates visited the mill of Strathmore Paper Co. at Woronoco, Mass.

Banquet

The official banquet of the Testing Conference was held on Thursday evening, September 29. Paul W. Bartholomew, general chairman of the conference, was the toastmaster. After introducing the persons seated at the head table, Mr. Bartholomew called upon Miss Helen U. Kiely, American Writing Paper Co., Holyoke, Mass., who introduced the guest speaker, A. E. Bachmann, president, Missisquoi Corp., Sheldon Springs, Vt.

Mr. Bachmann addressed the delegates on the subject of "Paper Testing from a Practical Standpoint." Emphasizing the importance of human relationships in handling mill problems, Mr. Bachmann discussed the various nontechnical or practical factors that enter into the handling of a mill testing and control program, and brought out the desirability of applying these factors in the extension of testing to new areas.

Exhibits

During the conference a display of instruments for testing pulp and paper and various raw materials used in their manufacture was open to the delegates. A list of the exhibiting companies and the instruments displayed by each is given below.

Allegheny Instrument Co., Inc., Cumberland, Md.—Formation Tester

American Sisalkraft Corp., Attleboro, Mass.—Ply Separation Tester

American Tradair Corp., Long Island City, N. Y.—Ekco Thickness Gage

Analytical Measurements, Inc., Chatham, N. J.—Analytical Pocket pH Meter

Ashton Valve Company

Crosby Steam Gage & Valve Co., Wrentham, Mass.—Burst Tester

Baldwin-Lima-Hamilton Corp., Philadelphia, Pa.—Crane Scales (Strain-Gage Type)

Beckman Instruments, Inc., Fullerton, Calif., Beckman Division—pH Meter, Flow Colorimeter

Beckman Instruments, Inc., Richmond, Calif., Berkeley Division—Reflecting Photoelectric Transducers Digital Recorder

C. A. Brinkman & Co., Great Neck, L. I., N. Y.—Automatic Gravity Balances, Specific Gravity Balances, Micro Projector, Microscopes, Photomicrographic Equipment, Reflector Meters

Broger Instrument Sales Co., Inc., Brookline, Mass.—Scam Industrial Annunciators, Hallikainen Color Alarm, Fielden Recorder-Controllers, Fielden Level Controllers, Baldwin Crane Scales (Strain Gage Type), Ruge Resistance Thermometer Elements, Datronic Displacement Indicator, Berkeley Reflecting Photoelectric Transducers, Berkeley Digital Recorder, Whitney Micro-Regulating Needle Valves

Brookfield Engineering Laboratories, Inc., Stoughton, Mass.—Print Tester, Viscometran

Brooks Rotameter Co., Lansdale, Pa.—Rotameters and Allied Equipment

Central Scientific Co., Chicago, Ill.—Infrared Moisture Balance

John Chatillon & Sons, New York, N. Y.—Tensile Tester, Asphalt Stability Testing Machine, Wax Consistometer

Crosby Steam Gage & Valve Co., The Ashton Valve Co., Wrentham, Mass.—Ashton Burst Tester

George W. Dahl Co., Inc., Bristol, R. I.—Miniature Valves for Control Purposes

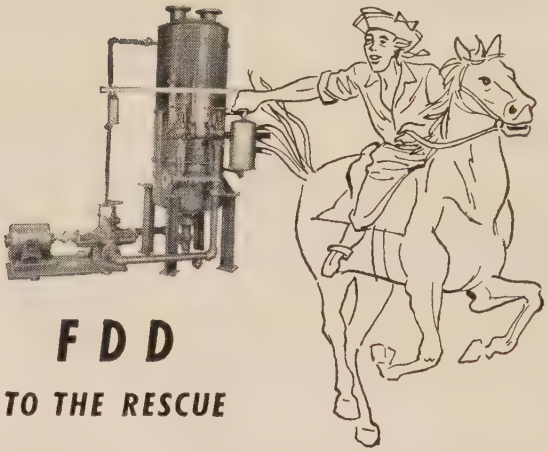
Daytronic Corp., Dayton, Ohio—Displacement Indicator

Doelcam, Boston, Mass.

Ekco Electronics, Ltd., Essex, England—Beta Ray Thickness Gage

Ercona Corp., New York, N. Y.—Carl Zeiss Surface Finish Tester, Carl Zeiss Large Universal Microscope with Accessories, Carl Zeiss Laboratory Microscopes

Fielden Instrument Division, Robertshaw-Fulton Controls Co., Philadelphia, Pa.—Recorder Controllers, Level Controllers



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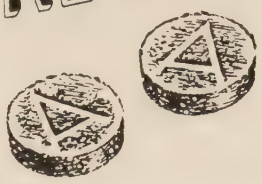

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Hillside Laboratory, Chicago, Ill.—Oil Absorption Tester
Hoyt-Grant Co., Inc., New Haven, Conn.—Representing Fielden Instruments
Hunter Associates Laboratory, Falls Church, Va.—Reflectance Meter Glossmeter
Hygrotester, Inc., Brooklyn, N. Y.—Portable Continuous Moisture Meter
The Impact-O-Graph Corp., Cleveland, Ohio—Impact Recorders
Industrial Instruments, Inc., Cedar Grove, N. J.—Megohm Meter, Automatic Voltage Breakdown Tester, Indicating Electrolytic Conductivity Meter, Recording Electrolytic Conductivity Meter
Instruments, Inc., Cleveland, Ohio—Sample Protectors
Laboratory Equipment Corp., St. Joseph, Mich.—Automatic Titrator for Sulphur Determination, High Frequency Furnace
La Motte Chemical Products Co., Towson, Baltimore, Md.—Organic Reagents Chlorine Tester Boiler Water Control pH Tester
Macalaster Bicknell Co., Cambridge, Mass.—Spectrophometer Microscopes
Rudolph Meyer's, Inc., Amsterdam, Holland—Printability Tester with Attachments, Ink Pipet with Accessory Drying Time Recorder Penetration Valumeter
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K. E. Saunders Agencies, Jamaica, N. Y.—IGT Testing Equipment
Scam Instrument Corp., Chicago, Ill.—Industrial Annunciators
The Sheffield Corp., Dayton, Ohio—Smoothness Tester, Porosity Tester
Testing Machines, Inc., New York, N. Y.—Size Tester, Motor Driven Micrometer, Initial Wet Strength Device, Vansometer Oil Absorption Tester, Marconi Moisture Meter, Photovolt pH Meter, Photovolt Reflection Meter
Viking Instruments, Inc., East Haddam, Conn.—Continuous Void Detector
W. M. Welch Mfg. Co., Chicago, Ill.—Pick Tester, Reflection Densitometers
West Virginia Pulp & Paper Co., Luke, Md.—Chapman Printing Smoothness Tester
Whitey Tool & Die Co., Oakland, Calif.—Micro-Regulating Needle Valves
Carl Zeiss, Inc., Jenna, Germany—Surface Finish Tester, Large Universal Microscope with Accessories, Laboratory Microscopes

Seventh Coating Conference

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PERSONAL MENTION

Items About New and Old Tappimen

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William D. Bell, Assistant Resident Engineer, Rayonier, Inc., Grays Harbor Div., Hoquiam, Wash.

Philip R. Blodgett, Head Librarian, Everett Public Library, Everett, Wash., a 1932 graduate of Bowdoin College.

William R. Blundell, Works Manager, Thames Board Mills Ltd., Mersey Works, Warrington, Lancs., England. Attended Palmer College, Grays, Essex.

Franklin F. Bogardus, Chicago District Manager, Roots-Connersville Blower Div., Chicago, Ill., a 1924 graduate of Rose Polytechnic College.

Leland G. Briggs, Product Design, Ray-O-Vac Co., Madison, Wis., a 1932 graduate of the University of Wisconsin.

Donald V. Brown, Chemist, Penobscot Chemical Fibre Co., Great Works, Me., a 1943 graduate of the University of Maine.

Kenton J. Brown, Chemical Engineer, Forest Products Laboratory, Madison, Wis., a 1947 graduate of the University of Wisconsin.

Kenneth F. Byington, Coating Chemist, Crown Zellerbach Corp., West Linn, Ore., a 1941 graduate of Oregon State College.

Adalberto Calvi, Chemist, Cartiere Ambrogio Binda, Milano, Italy, a 1944 graduate of the Industrial Institute of Bergoma, Italy.

William Carter, Vice-President, Canadian Ingersoll-Rand Co. Ltd., Montreal, P.Q., Canada.

K. Starr Chester, Technical Adviser to the Managing Vice-President, Alton Box Board Co., Alton, Ill., a 1928 graduate of Boston University with a Ph.D. degree from Harvard University in 1931.

John H. Coppens, Sales Engineer, H. Waterbury & Sons Co., Oriskany, N. Y., a 1955 graduate of the University of Maine.

Thomas M. Costello, Laboratory Assistant, Hurlbut Paper Co. South Lee, Mass.

Howard J. Cronin, Chemical Engineer, Research Div., International Paper Co., Glens Falls, N. Y.

Peter de Waard, Chemist, Hercules Powder Co., N. V., The Hague, Holland, a graduate of the State University, Groningen, Netherlands.

Allan Ha. Dowsley, Technical Control Supervisor, Columbia Cellulose Co., Ltd., Prince Rupert, B. C., Canada, a 1950 graduate of the University of British Columbia.

Wayne P. Ellis, Technical Director, Benjamin Foster Co., Philadelphia, Pa., a 1937 graduate of the University of Maryland.

Curtis Elmer, Research Chemist, Monsanto Chemical Co., Springfield, Mass., a 1951 graduate of Boston University.

Newell W. Emery, Jr., Project Engineer, Scott Paper Co., Everett, Wash., a 1950 graduate of the University of Maine.

Jacqueline M. Fetske, Supervisor of Printing Research, Lehigh University, Bethlehem, Pa., a 1946 graduate of the University of Pennsylvania.

F. Peter Ford, Student, University of Maine, Orono, Me.

Charles R. Furlong, Jr., Paper Inspector, Western Electric Co., New York, N. Y., a 1954 graduate of the University of Maine.

Gleb I. Goumeniouk, Industrial and Research Consultant, W. Vancouver, B. C., Canada, a 1936 graduate of the University of British Columbia, with a Ph.D. degree from the University of Wisconsin.

James L. Green, Jr., Assistant Power Superintendent, St. Regis Paper Co., Jacksonville, Fla.

James D. Griffith, Jr., Technical Superintendent, O. B. Andrews Co., Chattanooga, Tenn., a 1949 graduate of Missouri School of Mines and Metallurgy.

Raymond A. Guyer, Jr., Marketing Service Engineer, Luken Steel Co., Coatesville, Pa., a 1949 graduate of Pennsylvania State University.

Harry H. Haldeman, Research Chemist, The Upson Co., Lockport, N. Y., a 1925 graduate of Simpson College.

Ansel L. Hargraves, Chief Chemist, St. Joe Paper Co., Port St. Joe, Fla., a graduate of Georgia Institute of Technology.

Herbert I. Hess, Mechanical Engineer, Union Mills Paper Mfg. Co., New Hope, Pa., a 1949 graduate of the University of Pennsylvania.

James R. Hickey, Chief Research Chemist, Mosinee Paper Mills Co., Mosinee, Wis., a 1952 graduate of Lawrence College.

R. Bruce Holmgren, Editor, Package Engineering, Chicago, Ill., a 1942 graduate of Northwestern University, and a 1949 graduate of Chicago Kent College of Law.

Jay R. Janney, Manufacturing Trainee, International Paper Co., Niagara Falls, N. Y., a 1950 graduate of Clarkson College.

Harry E. Jackson, Research Engineer, The Consolidated Mining & Smelting Co. of Canada Ltd., Trail, B. C., Canada, a 1936 graduate of Loughborough College, Leicestershire, England.

Elmer C. James, Quality Control Engineer, American Greetings Corp., Cleveland, Ohio.

Ernst Klarer, President, Meypro Ltd., Weinfelden, Switzerland; and Business Manager, Meypro N. V., Zaandam, Netherlands.

Shigeru Kobayashi, Director, Kyoto Paper Manufacturing Co., Ltd., Kyoto, Japan, a 1917 graduate of Kyoto Imperial University.

Jack W. Kolybaba, Sales Engineer, The Black-Clawson Co., Inc., Bagley-Sewall Div., Watertown, N. Y.

James J. Kudrna, Superintendent, National Container Corp., Jaite, Ohio.

Harry F. Kruz, Assistant Sales Manager, Link-Belt Co., Philadelphia, Pa.

Thomas H. Larsen, Quality Control Supervisor, Lanzit Corrugated Box Co., Chicago, Ill., a 1952 graduate of the University of Chicago.

James A. Lewis, Student, Western Michigan College, Kalamazoo, Mich.

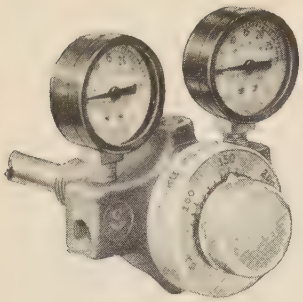
Bryan J. Lyons, Technical Representative, Rohm & Haas, Philadelphia, Pa.

Azel W. Mack, Vice-President, Dexter Chemical Corp., Boston, Mass., a 1915 graduate of Massachusetts Institute of Technology.

Jens C. Magnus, Engineer, Alfsen og Gunderson, Oslo, Norway, a 1934 graduate of the Technical University, Darmstadt.

Leander Manley, Secretary-Manager, Canadian Pulp & Paper Assn., Western Div., Vancouver, B. C., Canada.

Douglas C. McIntosh, Wood Technologist, Industrial Cellulose Research Ltd., Hawkesbury, Ont., Canada, a 1944 graduate of Queen's University, with a Ph.D. degree from New York State College of Forestry in 1954.



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George E. McKewen, Jr., Sales Manager, Tracerlab, Inc., Boston, Mass., a 1945 graduate of Massachusetts Institute of Technology.

Ewell B. Meadows, Jr., Development Engineer, Buckeye Cotton Oil Co., Memphis, Tenn., a 1950 graduate of the University of Alabama.

Fan Sun Meng, Graduate Student, University of Florida, Gainesville, Fla., a 1942 graduate of National Chiao Tung University.

Jerry S. Millis, Partner, Abbey Paper Stock Co., Philadelphia, Pa., a 1951 graduate of Temple University.

W. McGillivray Morgan, Research Manager, Monsanto Chemical Ltd., Fulmer, Bucks, England, a 1934 graduate of King's College, Durham University, with a Ph.D. degree in 1937.

Robert A. Norcross, Engineer, Norcross Corp., Newton, Mass., a 1952 graduate of the University of New Hampshire.

H. David Paavila, Technical Director, KVP Company Ltd., Espanola, Ont., Canada, a 1948 graduate of Queen's University.

Garrett S. Parker, Sales Engineer, Corning Glass Works, Corning, N. Y., a 1942 graduate of the University of Tennessee.

Elbert G. Parrish, Electrical Engineer, Crossett Paper Mills, Crossett, Ark., a 1951 graduate of the University of Arkansas.

Malcolm Pirnie, Jr., Partner, Malcolm Pirnie Engineers, New York, N. Y., a 1939 graduate of Harvard University.

James K. Powell, Instrument Engineer, Bowaters Southern Paper Corp., Calhoun, Tenn., a 1938 graduate of Mississippi State College.

Homer T. Ralph, Superintendent of Paper Mill and Parchment Div., The KVP Co., Ltd., Espanola, Ont., Canada, a 1934 graduate of Queen's University.

Walter J. Redmond, Assistant Chemist, International Paper Co., Kalamazoo, Mich., a 1952 graduate of Western Michigan College.

William G. Reed, Chairman, Simpson Timber Co., Seattle, Wash. Attended the University of Washington.

Jean W. Richer, Instrument Technician, Rolland Paper Co., Ltd., St. Jerome, P. Q., Canada, a 1946 graduate of Montreal Technical School.

Martin M. Sackoff, Chemist, The Bordon Co., Chemical Div., Bainbridge, N. Y., a 1953 graduate of the University of Delaware with a Ph.D. degree.

Lyle E. Schlavin, Application Engineer, Morden Machines Co., Portland, Ore. Attended Oregon State College.

Karlheinz Schoenrock, Chemist, Magic Valley Processing Co., Twin Falls, Idaho.

Bela A. Silard, Vice-President, Photovolt Corp., New York, N. Y., a 1923 graduate of the Technical University, Berlin, Germany, with a Dr. Eng. degree in 1924.

Francis J. Slama, Technical Salesman, Corn Products Sales Co., New York, N. Y., a 1948 graduate of St. Mary's College, Minnesota.

Fred H. Smith, Process Director, The Sharples Corp., Philadelphia, Pa., a 1937 graduate of Middlebury College, and a 1940 graduate of the University of Michigan.

Robert G. Spangler, Project Engineer, P. H. Glatfelter Co., Spring Grove, Pa., a 1953 graduate of Pennsylvania State Technical Institute.

Robert G. Stewart, Technical Supervisor, Crown Zellerbach Corp., Camas, Wash., a 1943 graduate of the University of Saskatchewan.

Daniel Stone, President, Perma-Flex Industries Ltd., Toronto, Ont., Canada. Attended the University of Toronto.

Alvin B. Storey, Coordinator of Packaging and Materials Handling, Celanese Corp. of America, Charlotte, N. C., a 1928 graduate of Lowell Technological Institute of Massachusetts.

Maurice B. Strelite, Equipment Engineer, Continental Paper Co., Ridgefield Park, N. J., a 1943 graduate of Michigan College of Mining and Technology.

Donald Strutz, Assistant to Works Manager, Appleton Wire Works, Inc., Appleton, Wis., a 1949 graduate of Lawrence College.

Robert H. Tompkins, Chemist, Electrical Testing Laboratories, Inc., New York, N. Y. Attended the Polytechnic Institute of Brooklyn.

Edward O. Travis, Engineer, J. E. Sirrine Co., Greenville, S. C., a 1948 graduate of North Carolina State College.

Leslie L. Turai, Director of Research, West Virginia Pulp & Paper Co., Mechanicville, N. Y., a 1938 graduate of the University of Budapest with a Ph.D. degree.

David A. Verner, Chief Design Engineer, Frank W. Egan & Co., Somerville, N. J., a 1943 graduate of Stevens Institute of Technology.

John R. Wilson, Superintendent, Hinde & Dauch Paper Co. of Canada Ltd., Trenton, Ont., Canada, a 1931 graduate of Riverdale Collegiate.

Charles S. White, Sales Engineer, Black-Clawson Co., Bagley-Sewall Div., Watertown, N. Y. Attended New York State College of Forestry.

TAPPI Notes

Joseph Abelson, formerly Student at the New York State College of Forestry is now in the Technical Department, W. C. Hamilton & Sons, Miquon, Pa.

Herbert B. Addington, Consulting Engineer, has transferred his office from New York City to Pleasantville, N. Y.

George J. Ahlquist, formerly of Longview Fibre Co., is now Project Chemist for Western Kraft Corp., Albany, Ore.

Austin Anthis, formerly Student at the Institute of Paper Chemistry, is now Senior Technologist for the Champion Paper & Fibre Co., Pasadena, Tex.

A. E. Bachmann is now President of the Missisquoi Corp. and Fonda Container Corp., St. Albans, Vt.

Paul C. Baldwin is now Vice-President in Charge of Research and Development, Scott Paper Co., Everett, Wash.

Kenneth Bowers, formerly of the Foxboro Co., is now Instrumentation Design Engineer for the Convair Div., General Dynamics Corp., San Diego, Calif.

F. E. Brauns, formerly of The Institute of Paper Chemistry (Retired), is now a Consultant, Victoria, B. C., Canada.

Emmett W. Bryan, formerly Engineer for Bryan Associates, is now with J. E. Sirrine Co., Greenville, S. C.

Frank L. Cessna, Jr., formerly of the New York & Pennsylvania Co., is now a Development Chemist for the Sorg Paper Co., Middletown, Ohio.

Chester H. Child is now Vice-President of the Merrimac Paper Co., Lawrence, Mass.

J. H. Davidson is now Chief Engineer in charge of the Central Engineering Div. and Manager of Mill Operation, Minneapolis & Ontario Paper Co., Minneapolis, Minn.

Joseph Edwards, formerly of Price Bros. & Co., Ltd., is now Special Consultant on Pulp and Paper Industry Activities for the Lummus Co. of Canada Ltd., Montreal, P. Q.

Hans V. Friberg, formerly Research Manager for the Swedish Cellulose Co., is now with A/B Fr. Ramstron, Stockholm, Sweden.

Donald M. Gilmore, formerly of the Rhinelander Paper Co., is now Control Chemist for the Brown Co., Berlin, N. H.

Robert E. Harper, formerly of the Rhinelander Paper Co., is now Resident Manager of the R. W. Paper Co., Longview, Wash.

Charles E. Hartford is now Vice-President of the Riegel Paper Corp., Acme, N. C.

William R. Haselton is now Mill Manager of the Rhinelander Paper Co., Rhinelander, Wis.

Henry S. Hooper is now Technical Director of the Penobscot Chemical Fibre Co., Great Works, Me.

Frederick L. Hudson, formerly of British Industry Plastics Ltd., is now Senior Lecturer in Papermaking Technology at the College of Technology, University of Manchester, Manchester, England.

Howard W. Hurd, Pulp Mill Superintendent of the West Virginia Pulp & Paper Co., has been transferred from Williamsburg, Pa., to Tyrone, Pa.

Bert Jones, formerly of the Southern Paperboard Co., is now Assistant Chief Chemist for the Rome Kraft Co., Rome, Ga.

Albert M. Kaiser of the West Virginia Pulp & Paper Co. has been transferred from Luke, Md., to New York City as Chemical Engineer.

Clement J. Kusnierek is now Chief Construction Engineer of the Minnesota & Ontario Paper Co., International Falls, Minn.

Joseph L. Lanford is now Paper Mill Superintendent of the Sonoco Products Corp., Hartsville, S. C.

John A. Luke of the West Virginia Pulp & Paper Co. has been transferred from Charleston, S. C., to Luke, Md., as Manager.

J. E. Caffrey, Jr., formerly Student at North Carolina State College, is now a Trainee with the International Paper Co., Georgetown, S. C.

William A. McKenzie of Simpsom Logging Co. has been transferred from Shelton, Wash., to Everett, Wash., as Chief Engineer.

Oscar L. Miller, formerly of the Durhaur Paper Board Co., is now President of Cartaseta A/G, Daniken, Switzerland.

Fred J. Newhard, formerly of the Scott Paper Co., Chester, Pa., is now Technical Control Director of the Marinette Paper Div., South Glens Falls, N. Y.

Richard W. O'Donnell is now Assistant Pulp Mill Superintendent of the Halifax Paper Co., Roanoke Rapids, N. C.

Melvin W. Olsen is now Plant Engineer in Charge of Maintenance of Simpson Logging Co., Shelton, Wash.

Doo Har Park, formerly Student at the Massachusetts Institute of Technology, is now Chemical Engineer for the Vulcan Cooper & Supply Co., Cincinnati, Ohio.

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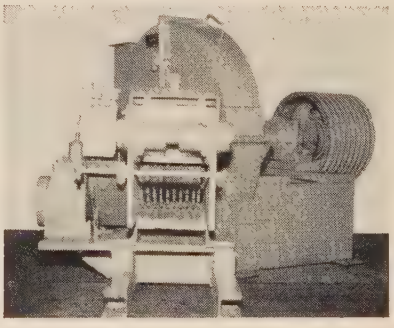

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D. K. Pattilloch, is now Consulting Engineer for the Michigan Research Laboratories, subsidiary of Sun Chemical Corp., Long Island City, N. Y.

Donald M. Platt is now Engineering Supervisor for the Crown Zellerbach Corp., Camas, Wash.

Geoffrey Pyner, formerly of the Tasmanian Board Mills Ltd., is now with the Associated Pulp & Paper Mills Ltd., Burnie, Tasmania, Australia.

Carl Raaka, Technologist of the Shell Chemical Corp., has been transferred from Gainesville, Fla., to New York, N. Y.

Douglas E. Read is now Executive Vice-President of the Industrial Cellulose Research Ltd., Hawkesbury, Ont.

Lawrence E. Robinson, formerly Student at the University of Maine, is now Senior Chemist for the Oxford Paper Co., Rumford, Me.

Wayne E. Robinson, formerly of the Champion Paper & Fibre Co., is now a Tour Foreman for the East Texas Pulp & Paper Co., Evadale, Tex.

W. Allen Schenk is now Assistant Manager of the Riegelsville, Hughesville, and Warren mills of the Riegel Paper Co., Riegelsville, N. J.

Alvin R. Sinclair, formerly of the Paper Applications Laboratory, is now Paper Industry Consultant for Koppers Co., Inc., Monaca, Pa.

John G. Strange is now President and Treasurer of The Institute of Paper Chemistry, Appleton, Wis.

Joseph C. Theiler is now Assistant Project Manager for the National Container Corp., Tomahawk, Wis.

Russell E. Vannatta is now Plant Manager of the Excello Paper Products Co., Cincinnati, Ohio.

Donald L. Voigts is now Technical Assistant to the Operations Manager of the American Box Board Co., Filer City, Mich.

William C. Walker, formerly of the National Printing Ink Research Institute, Lehigh University, is now with the West Virginia Pulp & Paper Co., Williamsburg, Pa.

Douglas M. Wallace is now Engineer for S. D. Warren Co., Cumberland Mills, Me.

Jack E. Weaver, formerly of the Rochester Paper Co., is now Plant Manager of the Wolverine Fabricating & Mfg. Co., Dundee, Mich.

Lawrence T. Welch of the Howard Smith Paper Mills Ltd. has been transferred from Cornwall, Ont., to Montreal, P. Q., as a Salesman.

Robert B. White is now Production Manager of the Sonoco Products Co., Hartsville, S. C.

John E. Wilbur, Felt Sales Representative of F. C. Huyck & Sons, has been transferred from Rensselaer, N. Y., to Glendale, Ohio.

Kurt A. Wohl, formerly of Stein, Hall & Co., Inc., is now in the Adhesives Sales Service Department of the Philadelphia Quartz Co., Philadelphia, Pa.

Chien-jo Yeh, formerly Student at the University of Michigan, is now in the Rubber Research Department of the University of Akron, Akron, Ohio.

* * *

Paul C. Baldwin, Vice-President, has succeeded *J. L. Ober* (retired) as the official corporate representative of the Scott Paper Co., Chester, Pa., in TAPPI.

Industry Notes

Production

Paper and board production during July amounted to 2,266,352 tons, according to the Bureau of the Census, Department of Commerce. This was 14% above the 1,995,219 tons produced in July a year ago. Paper production amounted to 968,217 tons, which was 13% above the 857,997 tons produced in July a year ago. The output of paperboard during this month was 1,028,000 tons reflecting an increase of 16% over the production of 886,812 tons reported during July, 1954.

Pulpwood

Pulpwood receipts at the pulp mills during July amounted to 2,738,434 cords, with consumption at 2,609,479 cords. Month-end inventories increased to 4,362,500 cords.

Receipts of pulpwood for the first half of this year were 15,483,000 cords, an increase of 2,068,000 cords above receipts for the comparable period in 1954. Domestic receipts increased 1,961,000 cords and imports, 107,000 cords.

Pulpwood consumption for 1955 through June was 16,481,000 cords, an increase of 2,127,000 cords above the same period last year.

Wood Pulp

Production of wood pulp for the first half of 1955 was 10,269,000 tons, an increase of 1,290,000 tons over production for the first half of 1954. June production was 1,768,000 tons, the fourth successive month that production was over 1,700,000 tons.

For the first half of this year wood pulp consumption was reported at 10,547,000 tons, an increase of 1,155,000 tons over consumption for the comparable period last year.

Wood pulp imports for the January–June period this year showed an appreciable increase over last year for the same months, though imports from abroad were approximately the same as last year. Total imports were 1,066,777 tons, an increase of 8% above last year. Imports from Canada increased from 821,786 tons to 896,431 tons while imports from overseas showed only a slight increase of 170,169 tons to 170,292 tons.

Exports of wood pulp continued at a high level and by the end of June totaled 316,084 tons, an increase of approximately 166,000 tons above exports for the first half of last year. This increase was equal to the total exports of wood pulp in 1953.

Newsprint

Production and shipments of newsprint in North America during August, 1955, amounted to 674,441 tons—an all-time monthly peak—and to 671,658 tons, respectively, compared with corresponding totals of 606,290 tons and 621,000 tons in the same month of last year. Output in the United States was 134,902 tons—the largest August volume on record except for 1926—and shipments were 137,037 tons while Canadian (including Newfoundland) production amounted to the all-time monthly high of 539,539 tons and shipments to 534,621 tons.

Through the end of August this year United States mills turned out 217,371 tons or 27.9% more newsprint than in the first eight months of 1954 while output in Canada also was 142,074 tons or 3.6% greater than in the corresponding period of last year, thus the continental increase totaled 359,445 tons or 7.6%.

Paper Consumption

The steady increase in the consumption of paper over the years has been due in large part to its transition from a limited use material to a necessity of life. That this has been—and is—a continuing process, is indicated by the fact that the relative importance of cultural papers (printing and fine) has steadily decreased, as their output between 1939 and 1953 dropped from 28 to 22% of the total tonnage manufactured. More important, however, than is reflected by these figures, the cultural papers have accounted for only 20%, while the utility grades have been responsible for 80% of the industry's growth over the period under consideration. Thus the area of greatest growth is delineated, and the reason grades comprising this group have received increasing attention from com-

panies desiring to increase the size and scope of their operations is clear.

The opportunities for growth in the utility grades has also had an effect upon the geographical distribution of the industry, the principal beneficiary being the south, where the available wood supply is particularly suitable for the production of kraft paper and board. Although the kraft industry was well-established in that area by 1939, it has, nevertheless, experienced phenomenal growth as the 1953 production of 9.4 million tons represented an increase of 233% over that of 1939. Over that period the output of southern mills increased by 6.6 million tons, equal to almost 50% of the industry's growth over-all. The percentage of total production originating in the area increased from 21 to 35.

Contrariwise, in the northeast and lake states region, where, with the exception of tissue and special industrial paper, mills have tended to concentrate on the production of the so-called cultural papers, growth has been relatively slow and the importance of the regions as factors in total production has been diminishing. Thus, while total production has increased by 96.5% between 1939 and 1953, that of the northeast and lake states rose by only 46 and 55%, respectively.

This being a dynamic industry, it may be expected that its grade structure will continue to shift as the industry reacts to developments in the economy by creating new products while continuing to supply traditional demands. It is considered likely that the emphasis on paper designed for utilitarian purposes will continue to be a major factor in industry growth, but the extent to which further improvements in high-yield pulping processes and increased use of hardwood species will affect the geographic distribution of production remains to be seen.

Growth of Per Capita Paper Consumption 1877–1954, by Selected Countries

	1877, lb.[a]	*1954, lb.*[b]
Scandinavia[c]	1.1	189.0
Russia	1.8	26.1
Italy	3.1	32.0
Austria	5.5	70.0
France	8.4	84.5
United Kingdom	11.0	161.1
Belgium	11.2	110.0
Germany	12.3	114.1[d]
Switzerland	23.8	140.0
United States	30.1	383.6

[a] Lockwood's *Trade Journal*—Aug. 31, 1878.
[b] APPA.
[c] Norway and Sweden.
[d] West Germany.

Wastepaper

For the fourth successive month this year wastepaper receipts have been well above 700,000 tons, in comparison to only one month last year, March. June receipts were 775,000 tons, and for the first half of this year totaled 4,397,000 tons, an increase of 387,000 tons above the first half of last year.

Consumption has also continued at high levels, and by the end of June totaled 4,456,000 tons, an increase of 414,000 tons above consumption for the first half of 1954.

Receipts and consumption of wastepaper for the last five years are as follows:

	First half year		*Last half year*		*Total*	
	Receipts	*Consumption*	*Receipts*	*Consumption*	*Receipts*	*Consumption*
1950	3,660,761	3,691,068	4,302,000	4,264,932	7,964,000	7,956,000
1951	5,155,472	5,073,813	4,096,528	3,997,187	9,252,000	9,071,000
1952	3,770,187	3,802,437	4,044,813	4,078,563	7,815,000	7,881,000
1953	4,281,713	4,348,444	4,145,287	4,182,556	8,426,000	8,531,000
1954	4,008,414	4,040,356	4,016,586	4,023,644	8,025,000	8,064,000
1955	4,396,873	4,454,734				

Belgian Congo

Active consideration is being given to the construction of two pulp and paper mills in the Belgian Congo. One mill would be built at Mayumbe. Annual production is scheduled at 50,000 tons requiring a tropical timber supply of 250,000 tons. A second project is proposed at Lake Leopold II. This plant would produce 30,000 tons annually, 20,000 tons of which would be set aside for export to Belgium, while 10,000 tons would be used locally for packing paper production.

Italy

The U. S. Department of Commerce has announced that a group of Italian financiers seek a 50% participation of American private capital for the creation of a cellulose and newsprint mill involving a total investment of $2,000,000, using straw and arundo donax cane abundant in southern Italy. A proposed minimum guaranteed production of 27 metric tons of white straw cellulose, 30 metric tons of newsprint and 3.65 metric tons of butane acetone ethane per day has been set.

Nova Scotia

Negotiations are under way between Hearst Publishing Co. and the Nova Scotia government on the construction of a pulp and paper mill at Sheet Harbor. Capacity of the mill would be 70,000 tons, principally newsprint. Cost would be $17,000,000.

Algae and Fish

Algae in lakes and rivers can cause mysterious overnight fish kills and within the next few hours cover up all traces of the deadly condition that they created, the Sulphite Pulp Manufacturers' Research League announced recently. Recent check-ups by League technical men reveal these little water plants are the probable culprit responsible for last summer's epidemic of fish kills in many different Wisconsin streams.

When fish suffocated without apparent cause at a Fox River point where repeated measurements showed dissolved oxygen was adequate for fish life day after day, League technical men recalled that algae give off oxygen during sunlight hours and absorb oxygen from the water at night.

Starting before sundown on a broiling Thursday, League men took water samples at a fixed station under scientifically controlled conditions every hour for 24 hours, and analyzed the samples for dissolved oxygen. When the sampling started at 6 p.m., oxygen was 3.05 parts per million, high enough to support fish life. Thereafter it dropped rapidly to 0.4 parts by 6 a.m. Friday, which is too low for most of the desirable fish species. Then as the sun rose, the oxygen started upward and reached 3.3 parts at 5 p.m. Friday. To an experienced technical man, that means that algae were responsible.

Farm fertilizers and residues from sewage treatment plants are increasing the algae growth and creating troublesome problems in many U. S. lakes and rivers. Measurements made during this summer's stream surveys which were conducted cooperatively by state authorities and industry technologists show that at least 100 tons of algae enter the Fox River every summer day from Lake Winnebago, and this

tonnage has a tremendous power to make the oxygen content of the water fluctuate widely.

Nitrogen and phosphorus nutrients in the water are responsible for the excessive algae growth that is causing odor and sludge problems along the shore of Green Bay near Oconto and Pensaukee, a four-man board of scientists from Appleton has concluded after field investigations and full laboratory tests.

No fibers from pulp and paper mills are contained in the trouble-making stuff, as had been asserted by fishermen and resort owners, the technical experts found. Neither do pulp and paper mill wastes contribute in any way to the algae growth.

The troublesome algae thrive in waters enriched by nitrogen and phosphorus compounds which generally are derived from heavily fertilized farm fields and from sewage, as in the Madison lakes and Lake Winnebago, the group's report pointed out under the signature of Averill J. Wiley, technical director of Sulphite Pulp Manufacturers' Research League, who headed up the technical task force.

"Pulp and paper mill wastes do not contribute nitrogen and phosphorus nutrients to the water," the official statement declared. "These wastes are strictly carbohydrates. Algae growths do not utilize carbohydrates. The odor complaints are in no way concerned with pulp and paper mill wastes," it concluded.

Associate members of the special committee were B. F. Lueck, League chief chemist; Robert Balch, biologist of The Institute of Paper Chemistry; and Teuvo Niemioja of Helsinki, Finland, visiting authority on pulping wastes. Wiley detailed the group's findings in letters to William Gallagher, Bay resort owner who first brought the situation to public attention, and G. L. Heath, vice-president of the Falls Paper and Power Co., whose mill had been getting blamed for the stench.

Diffusion Board

A cheap wood-fiber building board that filters poison gas, disease-laden particles, and the radioactive fall-out of atomic explosions from the atmosphere was announced recently by the U. S. Forest Products Laboratory and the Army Chemical Corps.

With the new material, developed by the laboratory under contract with the Chemical Corps, shelters can be built to protect troops and civilians from some of the most deadly effects of modern war. The material, called "diffusion board," is now being extensively tested by the laboratory and the Army Chemical Center, Maryland, for use in shelters.

The material, according to Major General William M. Creasy, Chief of the Army Chemical Corps, will put protection within everyone's reach when it becomes available. Present small-scale commercial production is for military testing purposes.

Developers of the new fiberboard are Alfred J. Stamm, veteran research scientist at the Forest Products Laboratory, and Harold Tarkow, his assistant. Both are members of the laboratory's division of wood chemistry, headed by Edward G. Locke. Messrs. Stamm and Tarkow worked closely with Leonard A. Jonas, Chemical Corps project officer in charge.

The diffusion board looks much like ordinary building fiberboards widely used in house construction. Secret chemicals in it screen out deadly gases and particles. Life-sustaining oxygen, however, passes through it so that persons inside shelters won't suffocate. Likewise, carbon dioxide gas given off in breathing can pass through it, along with respiratory vapors.

Pilot-scale production tests at two plants have shown that the fiberboard can be manufactured with much the same equipment used to make ordinary building fiberboards. Any species of wood can be pulped to make it.

The Folding Carton

Since its birth in 1879, the folding carton has grown up and become big business. Without it, this country's interlocking systems of mass production and national distribution would collapse. Because the savings made possible by this packaging, production, and distribution know-how are actually greater than the cost of the package, the expense of consumer goods has been materially lowered.

What makes a folding carton so adaptable to products ranging from packaged foods to cosmetics? The reasons are numerous. The variety of styles in which it can be constructed is limited only by human ingenuity. There are more than 200 carton styles in fairly common use and at least 200 more which are readily adaptable under proper circumstances—and almost any packaging quality or property can be put into a folding carton.

Since it takes the best of printing, it can hold its own with any printed product for sales appeal. Where other types of packaging are decorated with labels or wraps, the folding carton may receive high quality printing directly without an extra gluing operation.

Since the folding carton can be combined easily with other materials for product visibility, "windows" may be cut out of the carton during its manufacture and transparent film applied in a high speed operation. Other sales boosters, such as paperboard cut-outs, can be built right into the carton while in production or printed recipes and product use illustrations can be applied.

Like other mass production items, folding cartons are manufactured by precision methods which make the last carton off the assembly line the same as the first. Therefore, it is especially well-suited to the needs of large-scale packagers with high-speed filling machinery.

Because of the folding carton's low unit cost, the housewife shopper can be certain that most of her dollar is spent on the product, while only a fraction of the purchase price pays for the package.

The folding carton is many things.

It must be a container. Beginning as a piece of paperboard, the folding carton must be shaped, treated, and dressed up so that it will serve as a container for a specific product.

After the carton is filled, it becomes guardian of its contents—protecting against breakage, spoilage, contamination, deterioration, and other possible hazards enroute to the consumer shelf.

No matter how smoothly the carton speeds through the packaging machine, no matter how perfect the condition of its contents, the carton must sell its products—it must be an advertising medium and salesman. If not, its superior contents will never be known.

As an advertising medium, it must stimulate interest and attract attention. As a salesman, it should urge purchase by convincing the prospect. To do this, all characteristics and functions of the carton must be coordinated so the prospective customer will look, see, and believe that he is buying the best available product of its kind.

Because the looks of a folding carton are so important, when a client has a product which he wants packaged, trained minds must go to work. Sketches and models are devised and discarded until the designer and client are completely satisfied that they have the right carton for the job. The brains which create any new package design must ask and find answers for the following questions concerning product and market analysis:

What is the physical size and nature of the product and the exact types of protection it will require?

Who will buy the product, in what units, in what kind of stores, and for what purposes?

How much is known about the product?

What sales resistance against acceptance of the product

exist and what direct or indirect competition must be met and overcome?

When it comes to structural design, these questions must be answered:

What package is best suited to give the required protection and are these packages available, economical, and practical?

Does the package meet the practical requirements of handling, storage, and display in the retail stores where it will be sold?

Is it convenient for the ultimate consumer, offering ready examination prior to purchase if desirable?

Is this style package already familiar to the consumer or does it require the learning of new habits in order to become accustomed to its use?

Merchandising designers must know:

What is the brand name of the product? Is there a trade mark which must appear in the design?

What single advantage within the product can most effectively be stressed in the illustration and copy to induce immediate purchase?

What other factors does the product have which should be brought to the attention of the consumer?

What information about the product must appear on the package to meet legal requirements?

Will illustrations help demonstrate and prove the usefulness and desirability of the product? If so, how can they best show off the product to the consumer?

How are competitive products packaged and how can individuality be given to this one?

What color or colors will have the greatest attention value and appeal for potential customers?

Three fourths of the appearance factor in a package is color. While the printed words are directed to the mind, color must appeal to the eye and emotions. The two principal problems in relation to adopting color to folding carton design are the selection of proper colors and their standardization and subsequent control.

Selection of colors for a particular design depends on several important factors including harmony, visibility, psychological relationship of the colors to the packaged article, and consideration of where and to whom the package will be displayed as well as the color of light under which it will be viewed.

Harmony means that colors in the over-all design must possess a recognizable relationship—be pleasing to the eye.

Visibility is chiefly a matter of adequate contrast between the important factors of the design and the background. This is especially true of the product name or other specially pertinent information.

Psychological relationship implies that the colors on a folding carton should convey the special characteristics of the article packaged—a feeling of cleanliness, or of elegance, or of strength and durability. In this sense, pastel colors are often chosen for cosmetic designs because they convey daintiness and femininity.

The "color of light" in the location where the package will be viewed by shoppers has become important in recent years with the adoption of fluorescent lighting.

Adoption of standards is important so that the inkmaker, engraver, printer, and customer have the same specifications for shades and hues.

The prevailing method for color standardization is to check the proofs and printed folding cartons against a sample.

Many of today's hundreds of folding carton styles have been in common use for years—others have been recently developed. As new problems arise, folding carton companies are constantly striving to devise new constructions. No problem has proved too tough.

During the war, for example, more than a dozen manufacturers experimentally developed an incendiary bomb-fin out of paperboard to replace a metal fin. The industry was also called upon to produce a ration carton impervious to moisture and insects which could be dropped to troops from high altitudes without breaking.

In selecting a folding carton style, it is first essential to determine which of the following basic forms will best serve a given product:

The tube—a sheet of paperboard folded over, then glued against its edges to form a rectangular tube. The ends can be sealed or locked in a variety of ways.

The tray—a sheet of board with its sides folded at right angles and locked, glued, or stitched together at corners. One panel can be extended to form a cover or two trays can be fitted together to form the top and bottom of a complete box.

From these two primary designs have grown the array of styles regularly produced today.

Although the folding carton is today one of the most taken-for-granted items on the market shelf, merchandising techniques used as recently as the turn of the century would make the modern housewife shudder. The story of the "cracker barrel" era, where storekeepers paid little attention to sanitation or proper packaging methods has been told many times.

Not until after 1860 did the folding carton as it is known today make its debut. The first ones, carried only in the better specialty shops, were handmade and usually set up after each purchase by the retail clerk. Probably one of the first individual commerical containers was the "paper of tacks" handshaped by hardware clerks early in the century.

During the last quarter of the century, the techniques of the printing press were adapted to folding carton production. In 1879, the first shot was fired in the packaging revolution. According to the now-familiar story, the invention which led to the revolution resulted from an accidental discovery—a poorly adjusted printing press *cut* instead of printed an order of seed bags. When improved and adapted, this discovery resulted in remarkable improvements which reduce the cost of boxes and opened the way for the wide development of folding cartons.

The turning point in this development came in 1894. That year a number of cracker bakers merged into a national organization and decided to market a new-formula soda cracker throughout the country. In flavor and texture, this cracker was considerably better than any previously produced. The problem was how to keep it fresh and appetizing, clean and crisp, by protecting it from air and moisture.

The solution was found by packing the crackers in a folding carton with a waxed paper inner liner and completely sealing the product with a printed outer wrapper. Selection of a catchy trade mark permitted effective national advertising since customer identification of the cracker was insured.

The cracker, the package, and the advertising campaign based on the trade mark were all sensationally successful, marking the beginning of modern, streamlined packaging. Other manufacturers rapidly adopted the folding paper box. This, in turn, led to the clean and efficient markets which spread-eagle the United States today. Without the folding carton, the supermarket would still be only a fantasy, the modern efficiency apartment would be impractical and the wide variety of healthful foods which enable Americans to be the best fed people in the world would not be as readily available.

Today there seems to be no limit to the number of products packaged in the United States. Foods, drugs, cosmetics, hardware, clothing, dry goods, candy, toys, soap, sporting goods—the list could continue almost indefinitely. Every important item produced for general consumption is now packaged—to some degree—in folding cartons.

As a result, the industry has experienced a healthy expansion. In 1923, there were only some 203 manufacturing companies producing cartons for beans, sugar, raisins, cereal, crackers, butter, ice cream, oysters, eggs, salt, tobacco, drugs

and pharmaceuticals, suits, laundry, millinery, displays and cutouts, plus a host of other products.

Entering the second half of the twentieth century, the industry's steady growth is underlined by the fact that there are now more than 500 folding carton plants located in 38 states, employing about 50,000 people. These plants, varying greatly in size and scope of operation, represent an estimated investment of $155 million. There is no industrial center from Maine to California or Washington to Florida which does not have ready access to an adequate supply of folding cartons. The industry's dollar volume of sales has shown a steady average increase reaching more than $703 million in 1953.

The packaging revolution which elevated American merchandising from the cracker barrel to its present streamlined level is not over. Current surveys show continued gains in consumption of individually packaged items, replacing those products still sold in bulk.

Everywhere, packaging is creating more convenient buying —and technical improvements in manufacture of folding cartons are making them more adaptable to the job of delivering the goods attractively, cleanly, and economically.

The folding carton is probably the nearest to the universal unit package. The attractiveness of most consumer items can be enhanced by well-designed folding cartons. The principle of self-service merchandising which so radically altered the retail food business is spreading to other fields— and before long, many other commodities will be purchased by customer-selection without the help of retail clerks.

About 93% of total production is called "special order" or "tailor-made" cartons by the manufacturers. That is, they are produced to meet the customer's specifications after the order has been written.

The other 7% is the so-called stock items or commodity cartons. Manufactured in large quantities and available in standard sizes and styles, they are sold in smaller lots to retailers whose individual need would not ordinarily justify a special order. These folding cartons can be produced in especially attractive styles carrying the imprint of the individual merchant.

Two examples will illustrate how the market for folding cartons keeps expanding. Twice in recent times the industry has met the challenge of new fields and captured new markets. Shortly before World War II, the frozen food business experienced a phenomenal growth and folding cartons proved to be its most successful packaging unit—quickly acquiring a major share of the business.

This has been followed since the war by a definite trend to packaging in the fresh food lines—fruits, vegetables, and meats. The large increase in the number of self-service supermarkets undoubtedly has stepped up the tempo of this development. As long as the produce and meat departments operated in the traditional personal service manner they often constituted serious bottlenecks in the efficient functioning of supermarts which should enable a customer to make an unhurried selection of merchandise and then to exit rapidly once the selection has been made.

Packaging of fruits, vegetables, and meats proved attractive to the consumer because of the resulting convenience and ease of purchase. In addition, it substantially reduced costs due to the elimination of waste and increased efficiency of store operation.

The evidence is that folding cartons are a superior package for fresh fruits and vegetables, especially the fragile varieties which formerly suffered a high rate of spoilage. Not only do folding cartons offer protection and convenience, but they also have brought into this new field all their sales stimulating advantages.

Self-service demands modern packaging at its best. Therefore, the inevitable increase in self-service will make greater demands upon the folding carton—the retailer's silent but colorful salesman.

—from *This Is Sutherland*, August, 1955.

New Container Designs

Dow Chemical recently decommissioned one of its wooden containers for shipping 5 and 10-gal. drums of samples of liquid chemicals to foreign countries. Instead, it is now using a square, 600-lb., double-walled, corrugated box which, tests show, will provide a better cushion and have greater dent resistance than the former wooden container. This is typical of trends in the chemical industry, say Fibre Box Association representatives, where, more and more, the industry is coming to look to fiber boxes for packaging and shipping its products.

Illustrating the fiber box industry's bulk shipment service, one box maker has designed a corrugated box for Styron plastic pellets. The box measures 41 1/4 in. by 33 3/4 in. by 33 in., and consists of four parts—bottom lid, body (which slips into bottom lid), outer body (which telescopes over bottom lid and inner body), and top lid (which fits over the outer body). This bulk box shows great promise for shipments of large (1000-lb.) quantities of plastic pellet-type material. It saves storage space both before filling since it is received in a knocked down state, and after filling, since approximately one third more product can be stored in a given volume in the large bulk box than was possible with other previously used packages.

New designs not only allow for the safe packaging of large bulks but also adapt the fiber boxes to the requirements of granulated and liquid materials. For instance, Rohm & Haas ships anhydrous sodium thiosulphate, a photographic fixative, from its Bridesburg, Pa., plant in 2000-lb. capacity octagonal fiber boxes which are lined with waterproof crepe bag lining before the chemical is filled into the container. In a similar development, another manufacturer is impregnating his fiberboard containers with pesticides to prevent the infestation of lactose pharmaceuticals.

A trend equally important as the one reflected in this variety of bulk shipping improvements concerns the use of fiberboard containers in shipping small units of consumer items in safe and efficient fiber boxes. The do-it-yourself trend in hardware and paint stores has increased the number and packaging requirements for smaller units by around 25% over the last five years, say representatives of the packaging trade. Thus Solox, formerly best known for its industrial uses and now a popular window cleaner, is shipped in tin cans, packaged six units to a fiber box. This use alone, says the Fibre Box Association, absorbs thousands of fiber boxes. Users of these boxes report breakage resistance superior to other packing materials, which fiberboard engineers attribute to careful drop incline and bursting tests.

Fiber box designers are at work on equally ambitious ideas to be put into use in the near future. Fiber Box Association officials say they believe "there isn't one packaging job in wood, steel, or fabric that they can't improve through fiberboard."

—from *Chemical and Engineering News*, 33, No. 27 (July 4, 1955).

Paper Industry Medical Services

In a semiannual report of approved medical services in industry, the Occupational Health Institute announced recently that five plants in the paper industry have been awarded its Certificate of Health Maintenance. The recognition is given to those plants which comply with the standards for medical service in industry as established and approved by the Industrial Medical Association.

Plants within the paper industry that have been certified include: Chicago Carton Co., Chicago, Ill.; Dennison Manufacturing Co., Framingham, Mass.; Ecusta Paper Corp., Pisgah Forest, N. C.; Kimberly-Clark Corp., Memphis, Tenn.; Sonoco Products Co., Hartsville, S. C.

Paper Sales Potential

The nation's advertising agencies are almost untapped potential for the sales of paper, Jerome B. Gray of Gray & Rogers, Philadelphia, told the seventh annual breakfast meeting of the Paper Makers Advertising Association in Chicago.

The production departments and art directors of Philadelphia agencies, Gray has observed, are rarely visited by paper salesmen. This is extremely difficult to understand, Gray finds, in view of the fact that agencies have a key role in determining the amount and kind of paper consumed by their clients. There has been a decided trend in agencies to specify mill brands. Agencies can also do much to educate advertisers in the use of more and more printed advertising and thus sell more and more papers.

Noise Control Handbook

Available from OTS, U. S. Dept. of Commerce, Washington, D. C., at $8.00 per copy is Supplement I to the Air Force's "Handbook of Acoustic Noise Control, Vol. I, Physical Acoustics." Volume I is also available at $4.00 per copy, and Volume II, "Noise and Man" at $3.00 per copy.

Coosa River

A program to double the capacity of the Coosa River Newsprint Co. has been approved by its board of directors.

The project will increase manufacturing capacity of the pulp mill as well as the paper mill and will involve the installation of a third paper machine. The increased production is expected to come into the market early in 1958.

The south's second newsprint mill, Coosa River has been in operation since January, 1950.

Penobscot

As a result of a substantial research program on spent sulphite and soda liquors for many years, the Penobscot Chemical Fibre Co., Great Works, Me., and Boston, Mass., recently announced a new material for industry under the trade name "Penob."

It is a unique resin developed from spent sulphite liquor with a large surface area, either neutral or acid. The resin is hard, granular, porous, and infusible and offers interesting possibilities for use in the oil, plastic, and rubber industries.

New York & Penn

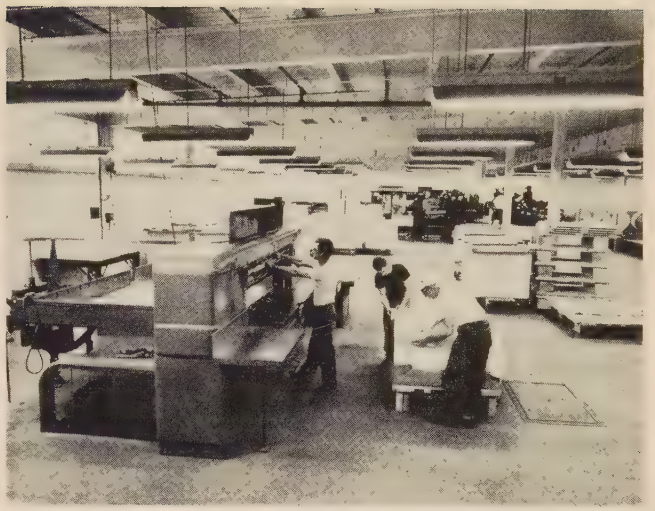
A new $1,200,000 stock preparation system has been started up at the Johnsonburg mill of N. Y. & Pa.

Constructed on practically the same design as a system that has proved successful at the company's Lock Haven mill, the new stock handling system incorporates the latest ideas in fiber treatment. With the new system, prepared stock is received, transmitted, adjusted, stored, blended, and delivered to the individual paper machines under precise control. In addition, dry and wet broke and reclaimed waste from all sources is collected. Reclaimed stocks are defibered in a hydrapulper and delivered to the stock system for re-use.

Sulphite stock is received at $4^1/_2\%$ consistency from the sulphite mill and stored. It is drawn from this supply, refined at $4^1/_2\%$, then dropped to $3^1/_2\%$ and held there. The refining of the soda stock, which is done separately, compares with this. The deinked stock is refined at a separate plant and is also precisely held at $3^1/_2\%$ and stored.

In operation, the flow of sulphite to each paper machine is regulated by a liquid level controller in the machine chests. The deinked stock and soda flows are then automatically regulated to the proportioning boxes, their flow being dependent on the sulphite flow.

Colors, in a dissolved form, are also added at the proportioning boxes. Prepared stock is then pumped to the existing jordan for final refining before being discharged into the machine chests.



New Harris-Seybold 85-in. hydraulic trimmer shown in operation at the Lock Haven, Pa., mill of the New York & Pennsylvania Co., Inc., is part of the $125,000 expansion of the finishing room that added 7500 sq. ft. of floor space and doubled finishing facilities

With the completion of the new broke system, the consistency of the refined broke will be controlled and the broke stock will be added at the machine jordan discharge box by a Ratosleeve flow control system. Stock flow and liquid level are controlled by 50 instruments located on a large control panel.

Other features of the new system are:

(1) Nine storage chests built by Stebbins of glazed tile each having a capacity of 42,000 gal. representing 16000 lb. of fiber in the $4^1/_2\%$ storage chests and 12400 lb. of fiber in the $3^1/_2\%$ storage chests. An Impco neoprene-covered agitator is installed in each stock chest.

(2) Dual Warren stock pumps are installed at all points in the system where an outage would affect the production of more than one machine. All pumps are equipped with DeZurik valves operated by Hanna air cylinders and Valvair solenoid valves actuated by the pump motor starters. These act as check valves to prevent reverse flow through the standby pumps.

(3) The piping system is completely stainless steel, type 316 ELC.

(4) Control and instrument air is supplied by two Ingersoll-Rand compressors each with a capacity of 304 c.f.m. at 100 p.s.i. One compressor supplies air for the entire system. The instrument air is dried by a Lectro drier before going to the control panel.

(5) A new sulphite mill storage tank of Stebbins glazed tile construction receives bleached, cleaned, controlled stock from a DeZurik regulator after passing over a stainless steel Impco washer at the end of a new Bauer cleaner installation.

(6) The refiners are E. D. Jones standard size jordans with special stainless steel fittings. There are six of these driven by 300-hp. synchronous motors. Motors and starters furnished by Electric Machinery & Manufacturing Co.

The installation also includes a Fischer & Porter stock regulating system, Taylor liquid level transmitters on each stock chest, DeZurik consistency control equipment, and a complete telephone intercommunication system with all departments.

New colors of press boards and other colored papers are planned for production by N. Y. & Pa. in the near future. New dyes are being considered for the production of these papers. With the new dyes, it is expected that the color can be bleached out of the broke and the broke stock returned for use in other grades.

Brown

William Robinson Brown, known to his associates and friends as "W. R.," passed away at his home in Dublin, N. H., on August 4. He was born at Portland, Me., Jan. 17, 1875, the son of William W. Brown and Emily Jenkins Brown.

It is difficult to do justice to the record of a man of such varied accomplishments as was W. R. Brown.

After receiving his formal education at Phillips Andover Academy and Williams College, from which he was graduated in 1897, he went to work for the then Berlin Mills Co.—now Brown Co.—which was founded by his father. At Williams College he was a member of Kappa Alpha society, and was manager of the football and baseball teams.

His foremost accomplishment was the successful management of Berlin Mills—Brown Co. and Brown Corp. woods operations from 1900 until his retirement in 1943. This included the important period of Brown Co. expansion and the trying period of the depression.

The expansion of woods operations included not only the major operation on the St. Maurice River, but also branch operations producing wood for Berlin under local managers at St. George, Lyster, Riviere Jaune, Bersimis, Trois Pistoles, Amqui, St. Epiphane, and St. Raymond. All local managers were selected by "W. R.," most of them trained on the Androscoggin operations, and they reported directly to him.

During this period he also built and operated eight miles of standard gage logging railroad in Millsfield, unique in that it was unconnected with any other railroad—the nearest such being 30 miles distant. Early mechanization of logging operations included steam log haulers and the first internal combustion motor driven log haulers.

From 1933 to 1941 Brown Co. woods operations were made possible by a financing operation arranged by "W. R." with the city of Berlin and the state of New Hampshire—a most original and successful cooperative financing plan that enabled the mills at Berlin to remain in operation, and that also provided needed employment in near by logging camps for many a local man. This contract was subsequently legalized by the legislature.

On the humanitarian side, many old-time lumberjacks will remember "W. R." for his liberal policy with respect to the men who worked in the woods. He always planned to pay a little more than his local competitors and he took an active interest in the living and working conditions in the camps. He established the first woods safety program known to us, and accident cases were hospitalized by the Brown Co. long prior to the enactment of the Employers Liability Law. For years a resident woods doctor was employed to care for the health of the men in camps, attending to accident cases, illnesses, and to sanitary conditions.

His interest in trees included their propagation. At one time Brown Co. operated the largest privately owned tree nursery in the United States, in connection with which certified spruce and pine seeds were made available to the public for the first time. He was for years a director of the American Forestry Association.

His knowledge of trees and their importance to the public was responsible for his appointment in 1909 as a member of New Hampshire's first Forestry Commission, and he served the state continuously as Forestry Commissioner until 1952. He helped Governor Bass write New Hampshire's forestry law, and helped select the first State Forester. He was Chairman of the Commission in 1924 when it conducted the first survey of New Hampshire's forest resources.

The New Hampshire Timberland Owners Association, primarily for fire protection and the first organization of its kind, was founded by "W. R." He was instrumental in starting a similar forest organization in Vermont. He organized and wrote the constitution and bylaws of the St. Maurice Forest Protective Association in 1912, the first to be established in Canada, and continuing to date. He organized the Kennebec Fire Protective Association in 1913.

Interest in forest protection led him to organize in 1917, the Timberland Mutual Fire Insurance Co., the first of its kind in the United States. He operated it for two years.

"W. R." served in Washington under Bernard Baruch in World War I and was chairman of the New England Commission sending 10 sawmill units to England in 1917. He was also given a commission as major to operate sawmill units in France, but due to imperfect vision was not allowed to go abroad.

In 1926 he was a member of the U. S. delegation to the World Forestry Conference at Rome, Italy, and traveled through Sweden and Finland to study forestry. He was a member of a party sent to Germany and Czechoslovakia in 1934 by the Oberlander Trust to study forestry.

Many of the forestry practices now in general use throughout North America, and which are pointed to with pride by the great timber companies, were originated by W. R. Brown or under his direction.

"W. R." and Austin Cary, the first forester to be employed by an American lumber or pulp and paper concern, formulated a program of sustained cutting which up to that time had been practically unknown in America. It was his work with W. R. Brown in the early 1900's that gave Cary the experience necessary for the great work he did later in reorganizing the forestry practices of the south.

At the height of his career, W. R. Brown had 5900 square miles of timberland under his immediate supervision, an area equal to that of the states of Connecticut and Rhode Island. His far-flung operations used all kinds of transportation, many of which he helped develop. He was as much at home behind a dog team winter cruising in the wilds of Quebec as he was riding an Arabian horse or driving a high-powered automobile.

The originality of his thinking, and for him to think a thing was to act on it, blazed many trails in the wood-using industries of the world.

His last contribution to forestry is a book entitled "Our Forest Heritage," which he had just completed and which is in the hands of its publisher.

"W. R." was also nationally known as a horseman. He studied horses in Arabia, was president of the Arabian Horse Club of America, bred many fine Arabians at his Maynesboro Farm and served on the U. S. Remount Board for several years.

Consolidated Water Power and Paper

A multimillion dollar expansion program is planned by Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis. A new paper machine designed to meet increasing demand for lightweight enamel papers used in magazine printing by large publishers is expected to be in operation by June 1, 1957. Location of the new machine, which is on order with Beloit Iron Works, has not yet been determined.

The new equipment will enable the company to increase enamel paper production by 30%. Last year the firm produced over 200,000 tons of enamel paper at its three book mills situated at Wisconsin Rapids, Biron, and Whiting, Wis.

Stone

Russell M. Mather has been appointed general manager of the Franklin, Ohio, mill division of Stone Container Corp., Chicago, Ill.

Marvin N. Stone and Jerome H. Stone have been appointed executive vice-presidents. Marvin Stone will direct and be responsible for all activities of W. C. Ritchie and Co., Chicago package manufacturing subsidiary, the paperboard mill divisions at Franklin, Ohio, and Mobile, Ala., and the containerboard division at Coshocton, Ohio. Jerome Stone will direct and be responsible for all activities of the corrugated shipping container plants at Chicago, Ill., Philadelphia, Pa., and Mansfield, Ohio.

H. P. Andrews

Gordon A. McCarrell has joined the laboratory staff of the H. P. Andrews Paper Co., New York, N. Y.

Thor

Thor Corp. has purchased Allied Paper Mills, Kalamazoo, Mich.

Riegel Carolina

Riegel Carolina Corp., Acme, N. C., offers a scholarship of $1000 per year, open to Riegel Carolina employees or their children.

Libbie

Libbie Printing Co., Boston, Mass., has purchased the folding box plant of Rexall Drug Co.

Harrisville

Harrisville Paper Corp., Harrisville, N. Y., has resumed operations and is producing newsprint on its two 114-in. fourdrinier machines. The mill was formerly owned by St. Regis Paper Co.

National Container

National Container Corp. has announced a new paperboard product called Fanfold. It is a continuous sheet for custom packaging, in lengths specified by the customer and in bundles folded lap-on-lap accordion style. Fanfold was designed and patented by National Container.

Fanfold is presented as the solution to the problem of the shipper with a variety of products of varied shapes and sizes, who would otherwise be required to stock a multitude of box sizes and even then would not provide fully for his needs.

Custom prescored longitudinally according to individual specifications, Fanfold makes packaging of odd shapes and sizes easy. A single fold can be formed into a wide range of dimensions.

National Container broke all previous monthly records during August in its mill and converting plant production. Paperboard production during August exceeded 45,000 tons while converting plant production exceeded 420,000,000 sq. ft.

Rayonier

New Jesup Mill

Rayonier Inc. will soon begin construction at Jesup, Ga., of a new advanced design chemical cellulose plant with an annual capacity of 100,000 tons. At a cost of approximately $25,000,000, the newest mill in the Rayonier cellulose network will be completed and placed in operation late in 1957, representing a part of Rayonier's $80,000,000 capital expansion program over the next three years.

The Jesup location was decided upon primarily because of the assured availability of water and timber, the two raw materials essential for chemical cellulose production. Other factors, such as the availability of a skilled labor force, adequate transportation facilities, the fine cooperation from both community and state officials, plus the advantages of consolidated land management and timber procurement operations, contributed materially to the site selection.

The newest mill, when completed, will bring Rayonier's annual production capacity to some 900,000 tons. The new plant is not an expansion of the Jesup facility, as the new mill will be a completely self-contained manufacturing unit.

Greatly increased world demand for such cellulosics as rayon, acetate, tire cord, cellophane and several leading plastics was the deciding factor in Rayonier's building an eighth mill so soon after construction of the Jesup plant, which was placed in operation in June, 1954.

Expanded cellulose production at this time is possible only in North America because in other likely areas of the free world expansion is restricted by the tree growth cycle. The United States' southeast, Canada's British Columbia, and Alaska remain the only locations in North America where sizable cellulose expansion can take place economically today.

New Chemical By-Product Plant

A seismograph charge, similar to that used in the oil fields, recently broke ground for construction of a new $1,000,000.00 silvichemical plant at Vancouver, B. C., which will for the first time produce Rayflo, a new oil well drilling mud dispersant, on a commercial scale. Officials of Rayonier Inc. and Alaska Pine & Cellulose Ltd., Rayonier's Canadian subsidiary, as well as Canadian government dignitaries, attended the ground-breaking ceremony.

Rayflo is a silvichemical, a term coined by Rayonier three years ago to describe complex organic tree chemicals other than cellulose. The new product resulted from a research program at the Rayonier Research Division at Shelton, Wash., and will be commercially produced on a significantly large scale for the first time at Vancouver. Residues from a nearby Alaska Pine operation will supply the essential raw materials for the new Rayflow plant.

Winston Scott has been named resident manager of the Shelton, Wash., Division of Rayonier.

Gair

Robert Gair Co., New York, N. Y., has opened a quality control laboratory at its Pennsylvania Corrugated Box Division, Philadelphia, Pa. The new completely air-conditioned laboratory is designed to serve all 16 of Gair's shipping container divisions.

Mead

The Mead Corp., Dept. PP, Dayton 2, Ohio, has published a book "Paper and Progress," telling the romance of paper and paperboard, their almost endless role in a modern society they've helped to make modern, and their power to lift living standards throughout the world.

Oxford

Harry L. Beach has been appointed general manager of the Woods Dept. of Oxford Paper Co., Rumford, Me.

Donnacona

R. A. Anderson has been appointed purchaser of Donnacona Paper Co., Donnacona, Que., succeeding E. L. Mayville, who has retired.

Mead–Chillicothe Paper

The directors of Mead Corp. and Chillicothe Paper Co., Chillicothe, Ohio, have approved an agreement for the purchase by Mead of the assets of Chillicothe. The latter will be operated as a subsidiary under its present management and policies.

Simpson

Charles L. Nordstrom, formerly personnel and safety director of Simpson Paper Co., Everett, Wash., has been transferred to the company's Seattle sales office. Walter S. Funk succeeds Mr. Nordstrom at Everett.

Scott

Scott Paper Co., Chester, Pa., and Compania Industrial De San Cristobal, S. A., Mexico City, Mexico, announced recently that the two companies are engaged in working out arrangements under which Scott would acquire an interest in San Cristobal in connection with the program for the manufacture and sale of sanitary paper products in Mexico.

Compania Industrial De San Cristobal now manufactures pulp from sugarcane bagasse. Paul C. Baldwin, vice-president in charge of Scott West Coast manufacturing operations, has assumed the additional responsibility of directing the company's staff engineering, research and development activities.

A milestone in Scott Paper Co.'s expansion and improvement program at its mill in Winslow, Me., was reached recently when Miss Maine "christened" a freight car containing Scott household towels made in New England for the first time. The christening ceremony took place at the Hollingsworth & Whitney Division of Scott, where expansion and improvement programs totaling some $14,000,000 are currently being carried out.

St. Regis

Expansion

St. Regis Paper Co. announced recently that work has started on the expansion program at its Jacksonville, Fla., mill. This includes the installation of a new 1000-ton-a-day kraft paperboard machine as well as expansion of the pulp production facilities there. Target date for the completion of the expansion program is May, 1957.

Engineers for the pulp mill and its buildings and equipment are J. E. Sirrine Co. of Greenville, S. C. Stevens & Rubens of Seattle, Wash., will engineer the board machine and its buildings and equipment. Construction will be handled by Tidewater Auchter Construction Co.

The new machine, which will be built by Beloit Iron Works, Beloit, Wis., will have a maximum speed of 2500 f.p.m. Over-all length of the machine will be 650 feet with a four-drinier wire 276 in. wide which will produce a trimmed sheet 255 in. wide.

Four or five additional wells each 1200 ft. in depth will be drilled in order to provide the 25,000,000 gal. of additional water required daily for the expanded facilities. This will make a total daily consumption of water at the mill of 35,000,000 gal.

To meet the power requirements for this expansion, a 30,000 kva. turbogenerator will be installed as well as two oil-fired steam boilers with a capacity of 200,000 lb. per hr., one bark burner of 135,000 lb. per hr.-capacity, and two recovery boilers each with a capacity of 140,000 lb. per hr. All steam will be generated at 625 p.s.i.

In addition, two new lime kilns, 9 ft. in diameter and 250 ft. long, will be installed as well as two new precipitators; two barking drums, 12 ft. in diameter and 67 1/2 ft. long; and two large chippers approximately 100 in. in diameter.

It will require an additional 80 carloads of pulpwood daily to supply the wood requirements of the new machine. This will bring total consumption of wood at the mill to more than 100 carloads daily.

Justin H. McCarthy, vice-president of St. Regis and chief engineer, pulp and paper, is in charge of the expansion program and Lawrence C. Crowder is project engineer.

Bryant Anniversary

One of the company's major printing and publication paper mills, located at Kalamazoo, Mich., observed the sixtieth anniversary of its incorporation on September 25. Founded in 1895 as the Bryant Paper Co., the Kalamazoo mill was acquired by St. Regis in late 1946 from Time, Inc., as part of the company's postwar expansion program. Time, Inc., had purchased the Bryant firm in March, 1945.

The Bryant Paper Co. was organized in 1895 by a group of local Kalamazoo citizens including Noah Bryant, who served as president until 1908, H. H. Everard, Frank H. Milham, and Charles B. Hayes. The second mill to be established in the Kalamazoo Valley area, Bryant in its early days produced plate and lithographic papers, white and tinted papers, matrix, interleaving, blotting, map, coupon folder and railroad papers, woven and laid subscription book and printing papers. When in full operation, the plant employed about 150 people and produced 75 tons per week.

In 1905, the Bryant firm acquired the Imperial Coating mill adjacent to the plant, opening the field of coated papers for the company. Superior Paper Co. was purchased in 1906 and four years later the Milham Division was constructed northwest of the original plant. By the mid-1920's, Bryant owned 11 paper machines, 24 coating machines and employed over 1200 men and women. Annual production grew to 75,000 tons of book and coated paper, making Bryant one of the leading book paper mills in the world.

St. Regis has invested over $4,500,000 in modernization of the Kalamazoo mill so that today production from its five paper machines and its coating mill equals that of the 11 paper machines in operation three decades ago when the Bryant firm ranked as one of the world's largest book paper mills.

Three paper machines have been reconditioned and one rebuilt since St. Regis took over the mill in 1946, while additional improvements have also been made in the stock preparation and storage system. The mill coating department has undergone several changes, including the installation of such modern high speed coating equipment as a Faeber coater, a double coater, and a Microjet or air knife type of coater.

Directly as a result of these improvements, plus long experimental work at the Kalamazoo research laboratory, St. Regis recently added two new improved quality sheets to its line of merchant grades of paper. Celluprint Enamel and Imperial Enamel are especially designed for high-quality letterpress printing with regular inks. Additional new St. Regis printing papers are expected to be marketed in the near future to keep pace with customer demand and present day trends in printing.

Riegel

The directors of Riegel Paper Corp. have taken action necessary to eliminate the company's subsidiaries, Riegel Carolina Corp. and Riegel Woodlands Corp. This consolidation was made effective as of October 3 and was authorized by the stockholders on September 27. The business of the subsidiaries will be continued as an operating division of Riegel Paper Corp.

Charles E. Hartford, vice-president of Riegel Carolina Corp. was elected a vice-president of the parent company and Richard C. Passmore, assistant secretary and controller of Riegel Carolina Corp. was elected assistant secretary and assistant controller of Riegel Paper Corp.

MacMillan & Bloedel

MacMillan & Bloedel Ltd., have announced that a contract has been signed between the company and Dominion Construction Co., Ltd., for carrying out the $40,000,000 expansion program to the Port Alberni Pulp Mill.

Project engineers are H. A. Simons Ltd., Vancouver, B. C., who designed and engineered the present mill, as well as MacMillan & Bloedel's Harmac mill at Nanaimo.

C. Crispin is MacMillan & Bloedel's vice-president—pulp and paper; C. W. E. Locke is general manager—pulp and paper department, and James Petrie is manager, Alberni Pulp & Paper Division.

The expansion will double the present capacity of 250 tons a day of sulphate pulp and will add a 180-ton general purpose and board machine and a 300-ton newsprint mill, with provision being made for a second unit. Plans call for the plant to be in full operation by early 1957.

C. Crispin, vice-president, pulp and paper, is now devoting his full time to supervision of manufacture at the company's two mills, and to construction details of the expansion at the Port Alberni mill, relinquishing his former responsibility for pulp sales.

R. M. Shaw, vice-president—sales, who has been handling world-wide sales of the company's lumber, plywood, and shingles is now placed in charge of pulp and paper marketing as well.

A. A. Hugman has been appointed manager, newsprint, paper and board sales and A. C. McGougan is now manager, pulp sales.

Harvey Kelley has been named machine room superintendent of the new Port Alberni mill.

Weyerhaeuser

Clark C. Heritage, who has devoted more than 40 years to forest products and chemicals developments, retired October 1 as Weyerhaeuser Timber Co.'s development director.

For Heritage, one of the nation's foremost figures in pioneering new wood, fiber, and bark products, retirement will not

mean the end of his career, since he will establish his own office in Tacoma to serve industry in the establishment, planning, and execution of research and development programs. He is a registered professional chemical engineer.

While Mr. Heritage will be concerned primarily with forest products, his future activity will not be limited to that field. His area of experience embraces organic chemicals, pulp and paper, and, more recently, a variety of wood and bark products.

Winton L. Patnode succeeds Mr. Heritage as Weyerhaeuser's research director.

Powell River

For the next fifteen months the most frequently mentioned word in Powell River will be Number 9. It is a common word in many quarters, but in Powell River it's a very special brand.

On Saturday, July 23, Harold S. Foley, representing the directors of the company, and F. Courtney Powell, longest service employee in the organization, jointly handled the official start of work on Powell River's latest and modern newsprint machine, Number 9.

In a simple ceremony Mr. Foley and Mr. Powell turned over the first shovelsful of earth on the new site. Immediately after the trucks and bulldozers moved in, and excavation procedures were under way.

For the information of those who know the plant, the new machine will be located near the mouth of Powell River, behind the present Kamyr building and paper storage area. This location will enable quick and easy passage of newsprint to wharf storage sheds.

The new machine is designed for speeds up to 2500 f.p.m. and will be equipped with couch transfer and every modern improvement. Work will be pushed vigorously ahead and production is expected to be under way in the fall of next year.

The installation of Number 9 involves considerable additional and subsidiary construction, which includes a new groundwood pulp mill and screen room; modifications and additions to the steam plant; revision of the wood preparation department and provision for supplying wood to the new groundwood mill. Other essential services for the new portion of the plant include stock and power supply, roads, sewers, etc. Total cost is expected to approximate $20,000,000.

Building contracts for the latest development program in connection with the ninth machine have been awarded to Northern Construction Co.

Glatfelter

P. H. Glatfelter Co., Spring Grove, Pa., have announced the award of a contract for the construction of a building to house a new papermaking machine. The contract was awarded to R. S. Noonan, Inc., of York, Pa., and the new building, which will cost in excess of $1,000,000, is scheduled for completion by June 1, 1956.

The new building is part of the $12,500,000 expansion program undertaken by the Glatfelter company at Spring Grove, including a new finishing room. The new paper machine will be a 188-in. high-speed unit capable of producing quality paper at rates up to 2000 f.p.m. The new facilities will permit Glatfelter to eventually increase its paper output by 33,000 tons a year and will provide employment for 75 to 100 additional personnel.

The new 620-ft. long structure will be two and three stories with approximately 182,000 sq. ft. of floor area. The outside walls will be constructed of insulated corrugated aluminum panels with corrugated plastic panels for natural light.

Crown Zellerbach

Crown Zellerbach Corp. has announced plans for construction of a $2 million multiwall bag plant as a companion unit for its projected kraft paper mill at Antioch, Calif.

Construction of the bag plant is scheduled to start in December and to be completed in mid-1956 along with the paper mill. About 10% of the new mill's output of kraft paper will be converted annually into some 54 million multiwall bags, used for packaging materials ranging from sugar to cement.

The bag plant, covering more than 170,000 sq. ft., will contain two high-speed, color printing presses, three tubers and bottomers and auxiliary equipment. Some of the equipment and the nucleus of the work force will come from Crown Zellerbach's present multiwall bag plants at San Leandro, Calif. and Port Townsend, Wash.

Crown Zellerbach and Pabco Products, Inc., have announced that negotiations are underway for the possible sale of Crown Zellerbach's interest in Fibreboard Products, Inc., to Pabco. Upon completion of the negotiations, the matter will be referred to the respective boards of directors of Crown Zellerbach and Pabco for approval.

Crown Zellerbach and Pabco each own 50% of the voting stock of Fibreboard, a western producer of paperboard products.

CZ-Gaylord

The Boards of Directors of Crown Zellerbach Corp. and of Gaylord Container Corp. recently adopted an agreement of merger of the two companies. The agreement provides for the merger of Gaylord into Crown Zellerbach, following approval of both companies' stockholders at special meetings November 22. Gaylord's 2,695,519 shares of common stock would then be converted into a like number of shares of Crown Zellerbach common stock after November 30, the contemplated effective date of the merger.

Mississquoi

Albert E. Bachmann has been elected president of Mississquoi Corp., Sheldon Springs, Vt., succeeding Walter B. Sheehan, who has retired.

International Paper

The Board of Directors of International Paper Co. have authorized further additions and improvements to the company's Mobile mill to provide for a new kraft paper machine. The new 282-in. Beloit machine will have an annual capacity of 100,000 tons of unbleached kraft paper. A substantial part of this tonnage will consist of grades presently being produced at Mobile, which will be transferred to the new machine. Present machine capacity made available by this transfer will be used to increase the mill's production of bleached kraft paper grades.

This expansion is in addition to the mill's current expansion program announced last spring providing for the installation there of a newsprint machine with 100,000 tons annual capacity and related pulp mill, power and other facilities. When this expansion program is completed, the Mobile mill will be the largest mill in the world manufacturing paper.

Although construction work was started on the company's newsprint mill during the spring, it will be possible to integrate this newly authorized program with the work already in progress. Both of the new machines are scheduled to begin operation during the summer of 1956.

Construction and equipment of the facilities for the new unbleached paper machine will add $18,000,000 to the $20,000,000 authorized earlier this year for the company's construction program at Mobile. It is expected that 825 additional persons will be employed at the mill in 1956 when the entire program is completed.

Completion of the current $38,000,000 modernization and expansion program will permit the company to produce a complete new line of bleached kraft papers it has never before produced in the south. The company plans to introduce a number of highly bleached grades at Mobile starting late in

1956. These grades, primarily in the business paper field, will supplement the company's popular line of bleached Springhill grades.

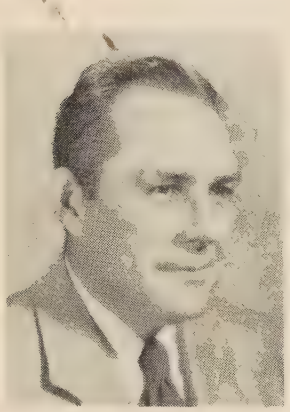
Simpson

William A. McKenzie has been named chief engineer supervising all engineering and maintenance activities at the pioneer Everett, Wash., manufacturing plant of Simpson Paper Co. Enlarged responsibilities and additional duties included in the reassignment cover the fields of cost control engineering, long range research and development for products, methods, and equipment, and company representation before local and state regulatory bodies dealing with fire protection, water supply, air and stream pollution problems, and legislative matters.

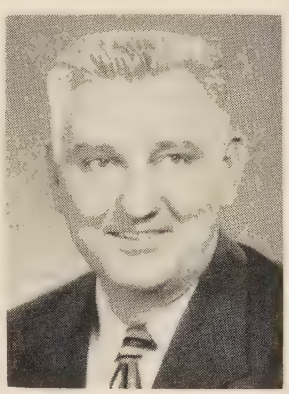
Melvin W. Olson has been named plant engineer in charge of all maintenance, including steam power production and plant facilities.

Sonoco

R. B. White who has served as superintendent of the paper mill at Sonoco Products Co., Hartsville, S. C., since 1946



R. B. White, Sonoco Products Co.



J. L. Lanford, Sonoco Products Co.

was named Hartsville production manager recently. J. L. Lanford was named paper mill superintendent and W. B. Haynes was promoted to the position of assistant paper mill superintendent.

North Carolina

Through special funds from the Pulp and Paper Foundation, Inc., the School of Forestry, North Carolina State College of Agriculture and Engineering, recently awarded 14 scholarships, worth $23,700, to top-ranking students planning to enroll in its pulp and paper training program.

First industry-wide scholarship program of its type in the nation, the grants will total $600 a year for each student, or $2400 for four years study, according to Dean R. J. Preston and Prof. C. E. Libby, Pulp and Paper curriculum head.

The Pulp and Paper Foundation is composed of 18 major pulp and paper companies in the nation working to help the college develop more specialists for America's sixth largest industry.

Companies supporting the Foundation program are:

Brunswick Pulp and Paper Co., Brunswick, Ga.
Buckeye Cotton Oil Co., Memphis, Tenn.
Camp Manufacturing Co., Franklin, Va.
Champion Paper and Fibre Co., Canton, N. C.
Continental Can Co., Hopewell, Va.
Ecusta Paper Corp., Pisgah Forest, N. C.
Gardner Board and Carton Co., Middletown, Ohio
Gaylord Container Corp., Bogalusa, La.
Halifax Paper Co., Roanoke Rapids, N. C.
International Paper Co., Georgetown, S. C.
The Mead Corporation, Sylva, N. C.
North Carolina Pulp Co., Plymouth, N. C.
Riegel Carolina Corp., Acme, N. C.
Hollingsworth and Whitney Co., Mobile, Ala.
Southern Paperboard Corp., Port Wentworth, Ga.
Union Bag and Paper Corp., Savannah, Ga.
West Virginia Pulp and Paper Co., Charleston, S. C. and Covington, Va.
Scott Paper Co., Chester, Pa.

The college, which is now erecting a $225,000 Pulp and Paper Laboratory, has been designated as the south's only approved pulp and paper technology training center by the Southern Regional Education Board.

The scholarship winners planning to enter the pulp and paper training program are:

Wallace D. Blalock, Winston-Salem, N. C.
John P. Clardy, Georgetown, S. C.
James S. Jackson, Plymouth, N. C.
George H. McEachern, Wilmington, N. C.
David C. Bourne, Georgetown, S. C.
Herschel H. Cabe, Sylva, N. C.
Ernest P. Capell, Pisgah Forest, N. C.
Ronald D. Cruea, Cedarville, Ohio
David H. Dillard, Sylva, N. C.
Ernest C. Franklin, Lynchburg, Va.
Harold N. Morgan, Candler, N. C.
Albert J. Rhodes, Jr., Brevard, N. C.
David W. Wright, Jr., Lynchburg, Va.
Paul D. Walker, Old Hickory, Tenn.

Western Michigan

A 13% increase in enrollment over that of 1954 has been registered by the paper technology department at Western Michigan College, indicating a continued and growing interest in this field of endeavor. A year ago the registrations climbed sharply from 62 to 92, as high school students began to learn the value and opportunities inherent in such training. And this fall saw the student body jump over the century mark.

With the addition of one part-time faculty member, Western Michigan paper technology department now includes five highly-trained and skilled teachers.

Headed by A. H. Nadelman, nationally known expert in the paper field, there has been assembled around him a fine staff. In point of service R. T. Elias ranks next to Mr. Nadelman, having taught here now for $3^1/_2$ years. Added just this fall are Carola Trittin and R. A. Diehm, both formerly with the Ward Paper Co., Merrill, Wis. Miss Trittin served as technical director and Mr. Diehm as vice-president and general manager.

Edward E. Stephenson, a WMC paper technology graduate now engaged in technical work for the Sutherland Paper Co., has been engaged to teach part-time in the department for this year.

I.P.C.

In recognition of the expansion of the pulp, paper, and board industry and of the growth of The Institute of Paper Chemistry, the membership of the Institute at their annual meeting, September 13, adopted amended Articles of Incorporation and By-Laws to enlarge the Board of Trustees from 16 members to 20. The revision also provides for rotation of a significant portion of the Board.

New members elected to the Board are Alexander Calder, Jr., executive vice-president and general manager, Union Bag and Paper Corp., New York, N. Y., Thomas B. McCabe, president of the Scott Paper Co., Chester, La.; and Howard Morgan, vice-president, Weyerhaeuser Timber Co., Tacoma. Wash.

Previous members of the Board who will continue to serve are:

Dan K. Brown, founding trustee, Neenah, Wis.
George E. Dyke, president, Robert Gair Co., New York, N. Y.
D. C. Everest, chairman of the board, Marathon Corp., Rothschild, Wis.
Sydney Ferguson, chairman of the board, The Mead Corp., New York, N. Y.
Stuart E. Kay, vice-president, International Paper Co., New York, N. Y.

A. B. Layton, vice-president, Crown Zellerbach Corp., San Francisco, Cal.
Donald S. Leslie, president, Hammermill Paper Co., Erie, Pa.
David L. Luke, Jr., president, West Virginia Pulp and Paper Co., New York, N. Y.
Ernst Mahler, founding trustee, Neenah, Wis.
George Olmsted, Jr., president, S. D. Warren Co., Boston, Mass.
W. Irving Osborne, Jr., president, Cornell Paperboard Products Co., Chicago, Ill.
Herbert T. Randall, vice-president, The Champion Paper and Fibre Co., Hamilton, Ohio
John L. Riegel, chairman of the board, Riegel Paper Corp., New York, N. Y.

Three *ex-officio* members are John Strange, president of The Institute of Paper Chemistry, Douglas M. Knight, president of Lawrence College, and Karl E. Stansbury, nominee of Lawrence College. Mr. Stansbury is chairman of the board, Thilmany Pulp and Paper Co., Kaukauna, Wis.

Officers of the new board are Ernst Mahler, chairman and W. Irving Osborne, Jr., vice-chairman.

Maintenance & Engineering Conference

The Seventh Annual Plant Maintenance & Engineering Conference will be held in Philadelphia, Pa., Jan. 23–26, 1956, and will take place concurrently with the Plant Maintenance & Engineering Show at Convention Hall in Philadelphia.

Chemical Exposition

The 25th Exposition of the Chemical Industries will be held at the Commercial Museum and Convention Hall, Philadelphia, Pa., Dec. 5 to 9, 1955.

Plastic Coating Corp.

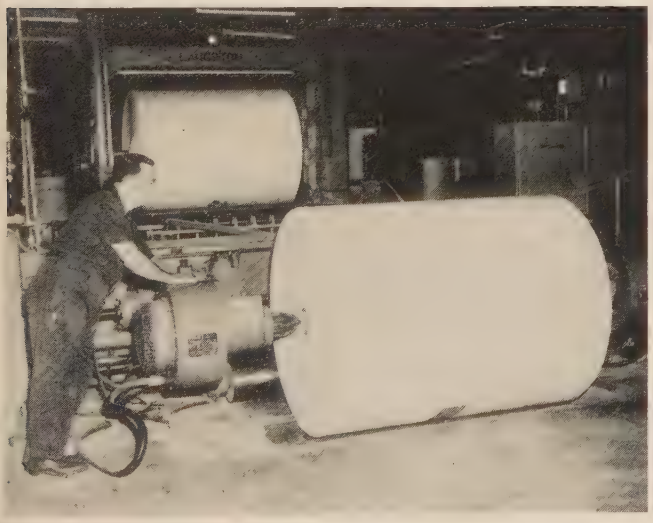
Victor J. Broto, Adrien G. McGrath, and Frederic A. Gill have joined the research section of Plastic Coating Corp. Laboratories, South Hadley Falls, Mass.

Langston

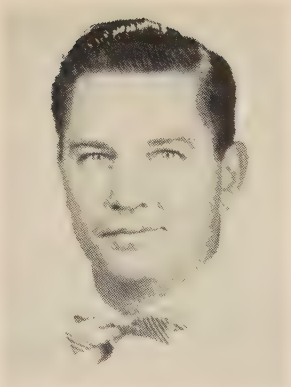
Samuel M. Langston Co., 6th and Jefferson St., Camden 4, N. J., has published a brochure designed to serve as a selling aid for corrugated shipping containers.

Langston has published a bulletin (No. 218) on power-operated shaftless roll stands.

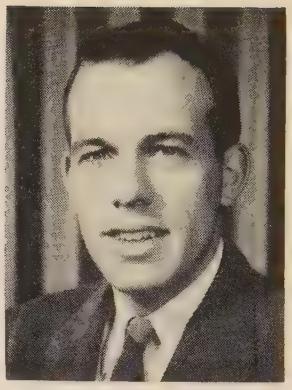
A special adaptation of a Langston mill roll stand and slitter-winder has been installed at Dixie Cup Co., Easton, Pa.



Recently installed at the Dixie Cup Co.'s plant in Easton Pa., this Langston shaftless mill roll stand (foreground) and slitter-winder are used to cut large rolls of paper, 50 in. diameter, into narrower rolls for processing into cups and lids



S. J. Knolls, F. C. Huyck & Sons



J. E. Wilbur, F. C. Huyck & Sons

Huyckfelt

S. Jay Knolls has joined the field service engineering staff of F. C. Huyck and Sons, Rensselaer, N. Y.

John E. Wilbur has been appointed felt sales representative for Huyck. Mr. Wilbur's territory will include Indiana, Illinois, Iowa, Kansas, Missouri, and Oklahoma.

F & P

Fischer and Porter Co., Hatboro, Pa., has published literature describing its new industrial ultrasonic flowmeter, which measures either mass or volume flow of almost any fluid, regardless of its electric conductivity.

Sandy Hill

The Sandy Hill Iron & Brass Works, Hudson Falls, N. Y., supplied combination fourdrinier-cylinder pilot paper machine for the Paper and Cellulose Research Center, Forest Research Institute, Dehra Dun, India.

Arnold M. Brown has been appointed southern sales representative for Sandy Hill.

Cyanamid

Harold E. Mongovan, Jr., has been appointed sales representative of the Organic Chemicals Division, American Cyanamid Ltd., in Ontario and Western Canada.

Per capita consumption of paper can be expected to rise to 1000 lb. per year by 1980, according to Clem W. Kohlman advertising manager of Cyanamid's Industrial Chemical Division. Mr. Kohlman cited the use of paper as a textile substitute and increased use of paper in automatic recording devices as factors tending to increase per capita consumption.

Torrington

The officers and directors of the Torrington Co., Torrington, Conn., were re-elected at the company's annual meeting recently.

Allis-Chalmers

John W. Becker has been named manager of the Syracuse district of the Industrial Group of Allis-Chalmers Mfg. Co., Milwaukee, Wis. Other Industries Group appointments are: V. L. Spinney, manager of the central region succeeding R. L. Halsted, who was recently appointed manager of the A-C processing machinery department; N. W. Landis, manager of the New York district and A. J. Mestier, Jr., manager of the Detroit district.

Available from A-C at 828 S. 70th St., Milwaukee, Wis., are: a leaflet (05R8341) describing the Silco-Flex all-silicone-rubber insulating system for motor and generator stator windings; a booklet (Tex-Book 20P40) giving selection data for Texrope drives and general technical information on V-belt drives; and a bulletin (52B6105C) describing A-C two stage pumps for boiler feed and other high pressure applications.

PATTON

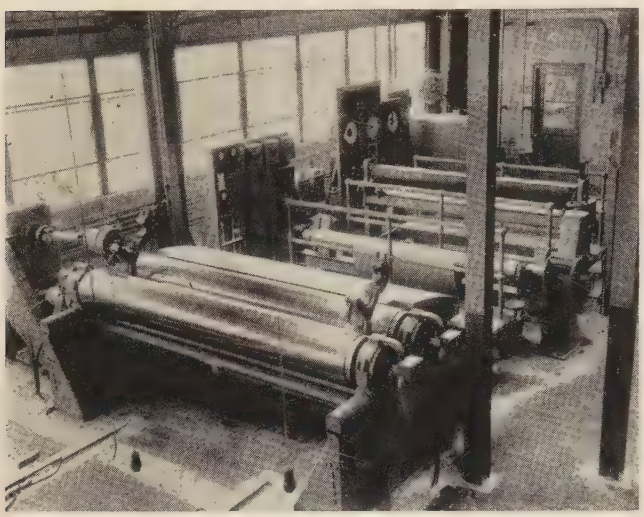
Charles W. Patton has been appointed director of Sales of Patton Mfg. Co., Springfield, Ohio.

NICHOLS

The Nichols Chemical Co., Montreal, Que., is building a plant near Thorold, Ont., for the manufacture of liquid aluminum sulphate.

BLACK-CLAWSON

The Dilts Division of the Black-Clawson Co., Fulton, N. Y., recently built a special machine for manufacturing phenolic impregnated paper tubes for high voltage transformers.



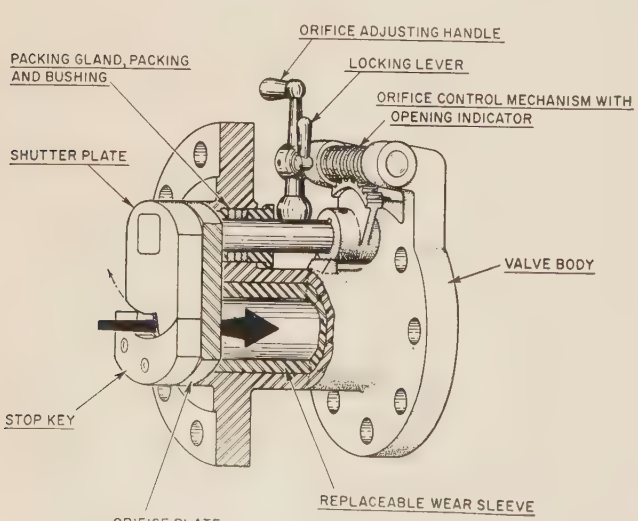
Phenolic tube winder

B-C's Shartle Bros. Machine Div., Middletown, Ohio, has issued bulletins describing four models of stock thickeners (#215B), discussing BlaCaloy ductile or spheroidal cast iron (#9-BC), and describing the Spiro-Flo Steam Joint (20SB).

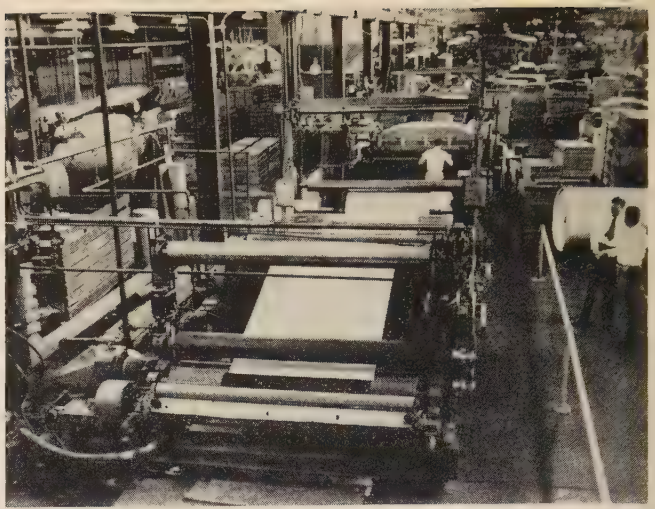
Karl F. Landegger has been elected chairman of the board of the Black-Clawson Co., succeeding Homer D. Martindale.

Charles S. (Chub) White has joined the sales staff of Bagley-Sewall, Watertown, N. Y., a division of B-C.

E. N. Peterson has been appointed works manager of B-C's Bagley-Sewall Division, Watertown, N. Y.



Black Clawson Spiro-Flow steam joint



New coloring and laminating machine at Mengel Corrugated Box Div., at Fulton, N. Y.

A new 80-in. B-C coloring and laminating machine has installed at Mengel Co., Fulton, N. Y., for use on bleached and unbleached kraft liners for corrugated boxes, at speeds up to 400 f.p.m. B-C's Pandia division has developed a digester blow valve which features micrometer adjustment of the orifice opening.

Lester M. Start has joined the sales staff of Black-Clawson.

DOWELL

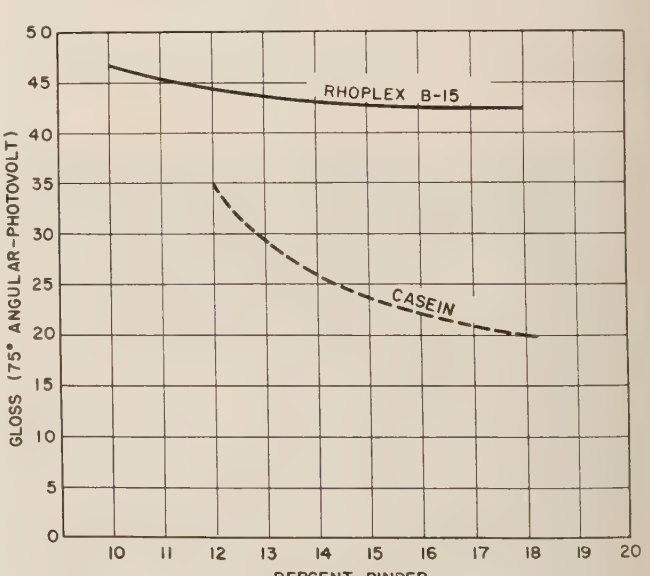
Dowell, Inc., P.O. Box 536, Tulsa, Okla., has issued a leaflet on Scale Removal from Paper Mill Lines.

PERMUTIT

The Permutit Co., 330 W. 42nd St., New York, N. Y., has issued a catalog sheet (CS-101), Preventing Corrosion in Drinking Water Lines.

ROHM & HAAS

Rohm & Haas Co., Resinous Products Div., Washington Square, Philadelphia, Pa., is offering Rhoplex B-15, a new

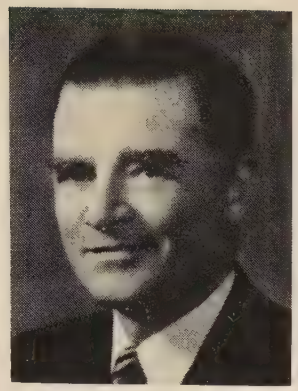


binder for pigmented coatings, developed particularly to produce high-quality coatings for folding boxboard.

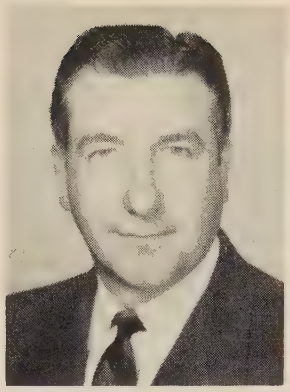
HARRIS-SEYBOLD

Harold W. Beder has been named general sales manager for Harris-Seybold Co., Cleveland, Ohio.

J. A. O'Brien, Johns-Manville Corp.



F. J. Wakem, Johns-Manville Sales Corp.



D. L. Hinmon, Johns-Manville Sales Corp.

R. F. Orth, Johns-Manville Sales Corp.

McLaurin-Jones

McLaurin-Jones Co., Brookfield, Mass., is now affiliated with Ludlow Mfg. & Sales Co.

Crane Co.

The American pulp and paper industry is saluted in a special issue of *Valve World* celebrating the 50th anniversary of the magazine and the 100th anniversary of Crane Co., Chicago, Ill.

Borden

The Borden Co.'s Chemical Division has announced plans for a synthetic resin plant in Manila to supply adhesives to the Philippine plywood industry.

Augustine R. Marusi has been elected president of the Borden Chemical Division.

Borden's Polyco Dept. has developed a new polyacrylate thickener Polyco 296-W, for use with paint latices and resin emulsions.

La Motte

La Motte Chemical Products Co., Towson, Baltimore 4, Md., has issued a new general catalog of La Motte equipment and chemical reagents.

Babcock & Wilcox

The Tubular Products Division of Babcock & Wilcox, Beaver Falls, Pa., has published a bulletin (TR-537), "Eleven Ways to Avoid Boiler Tube Corrosion."

Johns-Manville

C. George Dauchow has been appointed vice-president for customer relations of Johns-Manville Corp., New York, N. Y.

J-M has split its Industrial Products Division into three new operating divisions which will comprise a new industrial products group. John A. O'Brien will head the new group as a vice president, and Don L. Hinmon is appointed general manager of the Industrial Insulations Divisions and a vice-president of J-M Sales Corp. Thomas H. Eaton, production manager and vice-president of J-M Products Corp., will be a member of Mr. Hinmon's staff, which will also include J. B. Jobe, merchandise manager, who has been elected vice-president of J-M Sales Corp., and Edward D. Flavin, general sales manager.

Francis J. Wakem becomes general manager of the Packings and Friction Materials Division and continues as vice-president of J-M Sales Corp. His staff includes Phillip D. Cannon, production manager, who continues as vice-president of J-M Products Corp. and Edward H. Wells, merchandise manager and Clarence C. Simoni, general sales manager, who are elected vice-presidents of J-M Sales Corp.

Robert F. Orth becomes general manager of the Pipe Division and vice-president of J-M Sales Corp. His staff includes T. R. Turnbull, production manager, who is elected vice-president of J-M Products Corp. and George R. R. Wahl, merchandise manager, and John H. Goodwin, who are elected vice-presidents of J-M Sales Corp.

Norbute

The Norbute Corp. has purchased the assets of Jackson & Church Co., Saginaw, Mich., and Metalab Equipment Co., Hicksville, N. Y. The company is planning a major diversification program in industrial machinery and equipment.

Hewitt-Robins

Hewitt-Robins Inc., Stamford, Conn., has issued a bulletin (No. D-300) describing their Circular Log Feeder for feeding logs in one direction from a storage pile or conveyor belt.

Hooker

The Durez Plastics Division of Hooker Electrochemical Co. has brought into production a new $5 million plant at Kenton, Ohio, for the production of phenolic molding compounds.

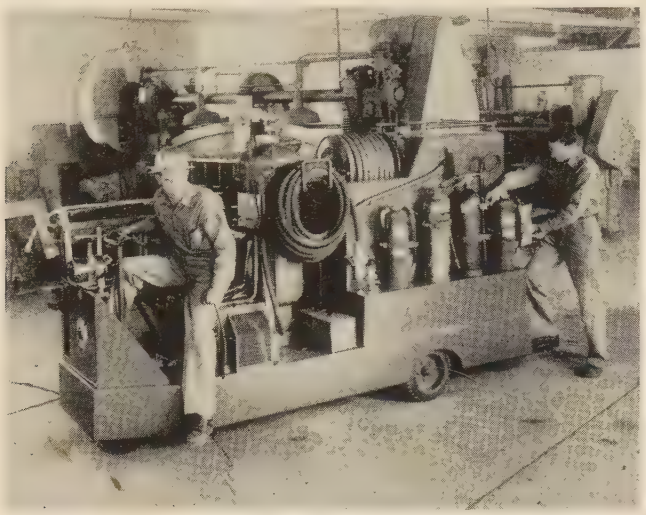
Huber

J. M. Huber Corp. recently put into operation a 9-yd. dragline at its Huber, Ga., clay mine. Weighing 1,320,000 lb., the new piece of equipment takes about 15 tons of earth at each bite and has a 220-ft. boom.

A new mammoth dragline, the largest in the State of Georgia, was recently assembled at the Huber, Ga. clay mine of the J. M. Huber Corp. The dragline is being used in Huber's clay mining operations to strip overburden

ANSUL

A new in-plant fire truck has been designed and manufactured by St. Clair Industries, Detroit, Mich., for exclusive distributon by Ansul Chemical Co., Marinette, Wis.



New in-plant fire truck, especially adapted to the need of plant fire brigades, has been designed and manufactured by St. Clair Industries of Detroit for exclusive distribution by Ansul Chemical Co.

MINNEAPOLIS-HONEYWELL

C. L. Peterson has been appointed vice-president and general manager of the Brown Instruments Division, Minneapolis-Honeywell Regulator Co.

BBD

Thomas V. Morris has been appointed to the sales staff of Bensing Bros. and Deeney in the Brooklyn and Long Island areas.

BBD has introduced a new "400X-Tra" series of Flexographic printing inks.

LODDING

Lodding Engineering Corp., Worcester, Mass., makers of doctors and blades has acquired Bailey and Blendinger Co. of Union, N. H., of machine knives. The resources of Lodding and of the now B & B Division will be united in the service of Lodding's field representatives.

CURTISS-WRIGHT

Downingtown Paper Co., Downingtown, Pa., has purchased nuclear measuring systems for basis weight at the wet and dry end of the paper machine, manufactured by Curtiss-Wright Corp., Wood-Ridge, N. J.

BELOIT

Beloit Iron Works, Beloit, Wis., has acquired the foundry and machine shop of Downingtown Mfg. Co., Downingtown, Pa. The Downingtown business will not be continued by Beloit. A new company is being formed, Beloit Eastern Corp., with the following officers: W. S. Wood, president, E. H. Neese, Jr., executive vice-president and treasurer, A. A. Neese, secretary, H. E. Tower, assistant secretary and treasurer, and H. Rodgers, general manager.

DU PONT

E. I. du Pont de Nemours & Co., Inc., is planning a $2 million addition to its Niagara Fall, N. Y., vinyl acetate plant.

STEIN, HALL

The Paper Dept. of Stein, Hall & Co., 285 Madison Ave., New York, N. Y., has published a technical bulletin, "Enzyme Converting of Starches for the Paper Industry."

SNELL

Muriel E. Warner, bacteriologist, has joined the staff of Foster D. Snell, Inc., New York, N. Y. Walter A. Bilz has been appointed a junior chemist and Salvatore J. Graziano has been appointed a chemist in the Snell Product Development Dept. Richard J. Davidson has joined the Product Evaluation Dept. as a chemist.

MAGNUS

Leroy McGuigan has been appointed manager of the Paper Mill Division of the Magnus Chemical Co., Garwood, N. J.

GOODYEAR

The Goodyear Tire & Rubber Co., Akron, Ohio, is carrying out a two-year plant expansion program at a cost of $100 million. The program includes new plants or additions at Akron, Ohio, Houston, Tex., Jackson, Mich., Niagara Falls, N. Y., Litchfield Park, Ariz., Glasgow, Scotland, Columbia, and Venezuela.

G.E.

General Electric Co., Schenectady, N. Y., has completed a $500,000 expansion of the testing facilities of its switch gear and Control Division laboratories.

G.E. is offering an improved line of d.c. armored motors with an advanced insulation utilizing class H materials. The class H insulated motor is being offered at no increase in price.

SNYDER

Wm. T. Hack has been elected president of Snyder Chemical Corp., Bethel, Conn.

FARRELL-BIRMINGHAM

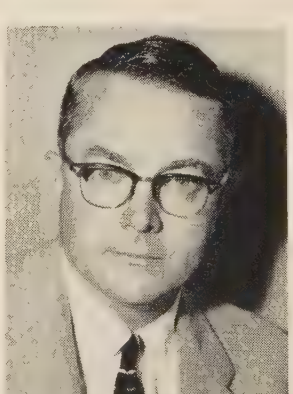
Farrell-Birmingham Co., Ansonia, Conn., has published a bulletin (No. 60) giving a report on how the company's Connecticut plants at Ansonia and Derby fared during the recent floods.

NOPCO

Nopco Chemical Co., Harrison, N. J., is planning construction of a new pilot plant for development work on industrial chemicals.

SANDWELL

S. D. Ford has been appointed chief engineer of Sandwell & Co., Ltd., Vancouver, B. C. Other new Sandwell appointments are, E. S. Barton, assistant chief engineer—projects administration; P. J. Jakomies, assistant chief engineer—development; J. A. Webster, assistant chief engineer—design; and S. A. Quist—procurement manager.



P. R. Sandwell, Sandwell & Co., Ltd.

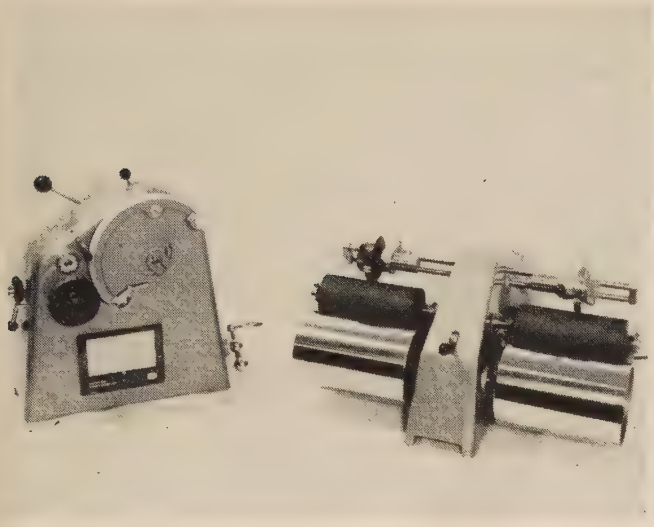
S. D. Ford, Sandwell & Co., Ltd.

SCAPA

The new drier felt plant of Scapa Dryers, Inc., is now under construction at Waycross, Ga.

MEYER'S

The I.G.T. printability tester, sold in this country by Rudolph Meyer's Inc., Amsterdam, Holland, is available from K. E. Saunders Agencies, 141-30 Pershing Crescent 1A, Jamaica-Briarwood 35, L. I., N. Y.



I. G. T. printability tester

The instrument is essentially a miniature cylinder press, which operates at accelerating speed. Variables encountered during the printing process can be deliberately changed, one at a time during testing, while the change of other variables can be reproducibly controlled to a high degree of precision. It is actually composed of two separate units, a distributing system and a printmaker. The printmaker is supplied with a pendulum-weight; a spring loaded drive attachment is also available. It gives results requiring only one test.

The desired printing pressure is attained through variable spring loading, by which system the pressure remains essentially constant regardless of differences in paper or board thickness. The applied fiber thickness is controlled within 0.1 micron.

The instrument is most convenient to use and has outstanding precision and sensitivity. It is designed especially for test printing and the determination of pick resistance is only one of the many tests which may be made. Other tests include: examination of the print for such qualities as vehicle absorption, smoothness, drying capacity, paper grain studies, detection of felt- or wireside, evaluation of fillers, coating, sizings, evaluation of paper machine changes designed to improve printability, color strength, density, gloss lightfastness, spectrophotometric measurements, etc.

The features of the I.G.T. printability tester are:

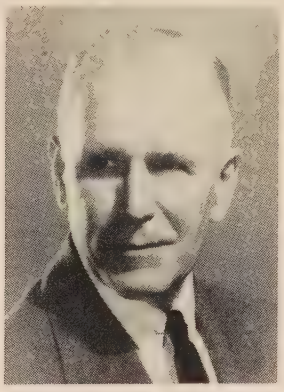
1. The acceleration principle requiring only one single test to establish a definite end point.
2. Three speed ranges, either 0 to 230, 0 to 500, or 0 to 750 f.p.m. which, with the smaller curvatures of the printing disks of the tester, gain splitting speeds equivalent to those normally found on high-speed presses.
3. Film thickness control within 0.1 micron.
4. Fine precision and high sensitivity for both arrangements (pendulum weight or spring loaded driven).
5. Ease of interpretation of results.
6. Adaptability to use for testing of paper and board stocks.
7. Adaptability to use for testing offset-printing.
8. As a picktesting device it finds both ink (or other medium) and optimal speed in a minimum amount of time, for while both tack and speed can be varied, the accelerating action makes for a minimum of hunting.
9. The I.G.T. printability tester is capable of detecting small differences in papers and boards.

OBITUARIES

Donald B. Bradner

Donald B. Bradner, consultant for the Development Department of E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., died as a result of a fall injury on Thursday, Sept. 29, 1955.

Mr. Bradner was born in Marion, Ind., on Nov. 26, 1891, and attended the University of Nevada. From 1908 until 1917 he was employed by several railroad and mining companies. In 1917–24 he was assistant chief of The Explosives Section of The Chemical Warfare Service in Washington, D. C., and Edgewood Arsenal. From 1924 to 1926 he was a consultant for du Pont. In 1926 he became director of research for The Champion Fibre Co., Hamilton, Ohio, where he remained until 1946 when he returned to du Pont as a consultant. While he was with Champion Coated Paper Co. and Champion Fibre Co. he became president of the Hamilton Laboratories, a chemical subsidiary company.



Donald B. Bradner

Mr. Bradner became a member of the Technical Association of the Pulp and Paper Industry in 1926.

Interment took place with military honors at Arlington Cemetery on Oct. 5, 1955.

Gustaf A. Peterson

Gustaf A. Peterson, 61, vice-president of Rice Barton Research Corp. and a former War Production Board Official and War Resources Board member, died on October 6 in the Memorial Hospital at Worcester, Mass. He was born in Worcester and was educated in the Worcester public schools. He served in the Army in World War I.

He joined Rice Barton Corp. in 1930 and served as chief engineer and then served as sales engineer before going to Washington in 1942 as engineering consultant in WPB's Paper Machinery Division.

In 1949 when Rice Barton Corp. formed Rice Barton Research Corp. as a wholly-owned subsidiary, Mr. Peterson was named vice-president of the Rice Barton Research Corp. and served in that capacity until his death.

Gustaf A. Peterson

Mr. Peterson was a member of the industrial committee of the Lowell Technological Institute, a member of the Worcester Sales Executive Club, and the Technical Association of the Pulp and Paper Industry since 1928.

TAPPI DIVISIONS AND COMMITTEES

Reports of Activities

Nonfibrous Materials Testing Committee

A meeting of the Nonfibrous Materials Testing Committee was held at Springfield, Mass., Sept. 28, 1955. The meeting was called to order by the Chairman, K. H. Williams, of Mid-States Gummed Paper Co., with the following persons present:

W. R. Willets, Titanium Pigment Corp., New York, N. Y.
D. D. Ritson, American Cyanamid Co., Stanford, Conn.
T. S. Morse, Hercules Powder Co., Wilmington, Del.

D. D. Ritson was appointed temporary secretary. S. J. Batruk of New Jersey Zinc Co., was invited to become a member of the committee.

The various projects were reviewed and discussed at some length. W. R. Willets advised that the final draft of the Specification on the Analysis and Testing of Opaque Pigments will be forwarded to the Standards Committee in the next few weeks. Also a revision of T 627 m will be submitted.

S. J. Batruk was requested to undertake the task of formulation of standards for zinc sulphide and zinc carbonates.

The examination of possible revision of a group of old standards as assigned to T. S. Morse were discussed. Mr. Morse will have the preliminary report on these early in December, and those requiring rewriting will be set up as projects.

The work of the Adhesive Subcommittee was summarized by the chairman. This is a very active group and are endeavoring to make available information to the papermakers as to the evaluation of the numerous forms of adhesives on the market.

The progress of the Animal Glue Subcommittee was presented, indicating that the work is going forward but is not yet in TAPPI form.

The revision of TAPPI method for Analysis of Sodium Silicate was given to the committee and carefully read over. The corrections, with a few minor suggestions were approved and as such will be presented to the Standards Committee.

At the request of E. E. Stephenson of the Routine Control Methods, C. C. Kesler of Penick & Ford, was appointed to represent the group in that project. T. S. Morse acceded to the request of the chairman that he act as vice-chairman. The appointment of the permanent secretary was deferred for the present.

The chairman discussed the need of bringing T 605 m-44 on the Sampling and Analysis of Coal in line with the newer ASTM method. D. D. Ritson was requested to consider this project after getting in touch with the proper ASTM committee under which this subject might come and secure their help.

The meeting closed with a discussion of new fields in which projects should be instigated. Those suggested largely in the fields of pigments were:

Talc
Calcium Carbonate
Diatomaceous Earth
Identification of Starches

The session adjourned after setting up the next meeting for February 20, in New York.

D. D. Ritson, *Sec. Pro Tem*

Paperboard Testing Committee

A meeting of the TAPPI Paperboard Testing Committee was held at the Sixth Testing Conference, Sheraton-Kimball Hotel, Springfield, Mass., Sept. 28, 1955. Members present were: F. E. Field, *Acting Chairman,* K. M. Winrich, H. W. Verseput, L. K. Burnett, W. E. Watson, R. G. Clark.

A report of the Ply-Bond Testing Subcommittee was submitted by L. K. Burnett and is included in this record.

Ply-Bond Subcommittee Report.—A review of the literature reveals one test designed specifically to measure ply-bond strength of paperboard. All the remaining tests are designed to measure only the force necessary to lift or rupture the top or printing surface from the remainder of the sheet, or the force necessary to split thin papers (0.010 in. or less).

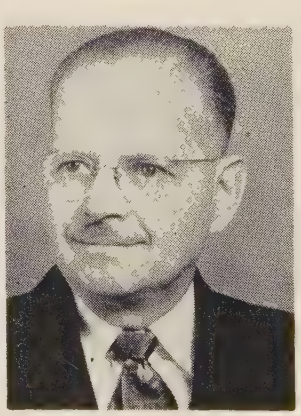
The single ply-bond strength test on record is one developed by Halladay and Luey. This determination makes use of a ply-bond tensile test on a washer-wax-board unit, and is performed on a 2 sq. in. sample with no. 20 Dennison wax adhesion diameter varying from 0.375 to 0.625 in. The following relationship was developed as a result of data:

$$F = aD$$

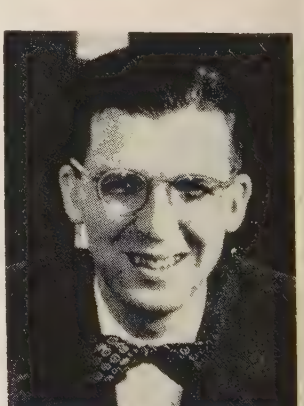
F = force per lineal inch to produce rupture
a = constant of board
D = diameter of washer

When the washer diameter is small, this test locates reliably the weakest point in the board as well as the force necessary for rupture.

ASTM has a tentative method of test for ply adhesion of paper, which precludes a split in the middle of the paper rather than at the weakest ply bond in the paper. Brecht and Bauer studied ply separation of couched papers and boards, but again initial separation of plies before testing determines the bonding strength involved. Duncan Brown developed a tearing tensile method to determine bonding strength between any two plies, but not the weakest point in the sheet. Fibreboard's San Joaquin Division apparently uses a test similar to this in measuring internal bonding strength of fourdrinier bleached kraft board. They have also had experience with the sisal kraft internal bond tester, and modified the Kilham Engineering design to produce more reliable measurements.



E. K. Williams, Midwest Gummed Paper Co.; Chairman, Nonfibrous Materials Testing Committee



E. E. Stephenson, Jr., Sutherland Paper Co., Chairman, Routine Control Methods Committee

Our experience has included work with a variety of tests such as flexing the sheet through steel rolls, shearing the sheet apart on the tensile tester, pulling the sheet apart by means of transverse tensile, tearing a glue seam and triangulation. We have had fairly good success only with the transverse tensile test, which determines precisely the force in lb. per square inch circular sample which is held between two steel platens by means of a double-coated pressure sensitive tape. One platen is fixed and a known rate of loading is applied to the movable platen until bond rupture results. The force in pounds to produce rupture is measured on a direct reading lever arm scale, and the point of separation is noted from the separated sample.

We are also working with a ply bond test which makes use of a Mullen tester. This test, developed by Gair Research Laboratories, makes use of an annular sample held between an annular brass plate and a solid brass disk by means of double coated pressure sensitive tape. The opening in the annular ring fits over the Mullen tester diaphragm, and the annular ring is held between the Mullen stage and the clamping platen by means of a spacer placed on the edge of the ring. When the diaphragm is expanded through the hole against the solid brass disk, the board is ruptured at the weakest point, and the force in pounds is read directly on the Mullen gage. This test has been found to be fairly reliable in predicting ply separation difficulty, and seems to correlate with the ply-bond tensile test according to available data.

From a practical off-machine standpoint, it would be our recommendation that the Mullen ply-bond tester be evaluated more fully by others. We feel it is the best of the tests available and has predicted actual ply-bond failure on converting equipment fairly consistently.

H. W. Verseput of the Gair Co., which developed the Mullen ply-bond method, illustrated the use of the equipment and the equipment itself with slides presenting the method described in the above report. The method developed is attached as a separate report.

The motion was duly made and approved to submit the Mullen ply-bond method to the TAPPI Routine Control Methods Committee for adoption.

Stiffness.—The subcommittee investigating stiffness of paperboard reported that work was underway assembling data of the various factors affecting stiffness and a definite report will soon be forthcoming.

New Business.—A report of the committee reviewing present TAPPI Standards suggested three present standards for consideration with respect to paperboard testing:

T404: Tensile Breaking Strength of Paper and Paperboard
T440: Alkali-Staining Resistance of Paper
T441: Water Absorptiveness of Nonbibulous Paper and Paperboard
T432: Water Absorption of Bibulous Paper

This committee submitted the Sutherland curl gage and complimentary method for consideration as a Routine Control Test Method for curl.

The changes recommended by the reviewing committee will be forwarded to the Testing Committee members for review before the next meeting.

A report was presented to the committee by the acting chairman outlining the TAPPI procedure for establishing research projects. A general discussion took place concerning the various procedures necessary.

A subcommittee consisting of H. W. Verseput and L. K. Burnett was appointed to investigate potential projects from the standpoint of paperboard characteristics and printability functions.

William E. Watson, *Secretary*

Routine Control Methods Committee

The Routine Control Methods Committee met for the first time at the 6th TAPPI Testing Conference in Springfield, Mass.

The meeting was organizational in nature and objectives and methods of operation were the only items on the agenda. It was agreed that Routine Control Methods might originate in regular testing committee activity or that such methods might be referred directly by TAPPI members.

Each member of the new committee also serves as a member of another Testing Division Committee. In this way, the Routine Control Methods Committee will be able to provide adequate resources for review of specialized methods by referral to special representatives.

Members of the new committee are as follows:

Member	*Testing Division Committee Represented*
K. M. Winrich Cornell Paperboard Products Co. Cornell, Wis.	Paperboard Testing
R. S. Hunter Hunter Associates Laboratory Falls Church, Va.	Optical Methods
I. H. Isenberg The Institute of Paper Chemistry Appleton, Wis.	Microscopy
H. J. Schlotter Hoerner Boxes, Inc. Keokuk, Ia.	Container Testing
R. J. Becker Riegel Paper Corp. Milford, N. J.	Paper Testing
F. A. Delforge Robert Gair Co., Inc. Norwich, Conn.	Pulp Testing
D. R. Cushman Socony-Mobil Oil Co., Inc. Brooklyn, N. Y.	Wax Testing
P. K. Wolper Riegel Paper Corp. Easton, Pa.	Packaging Materials

E. E. Stephenson, *Chairman*

Paper Testing Committee

A meeting of the TAPPI Paper Testing Committee was held on Sept. 27, 1955, at Springfield, Mass. The meeting was presided over by L. Price, chairman. Thirty-eight members and nonmembers were present. By invitation there were several members present from subcommittee III, of Paper and Paper Products Committee D6, ASTM. At present there are 25 members registered on the Paper Testing Committee.

Three test methods have been revised by the committee. Ballot votes by the committee approve of the revisions and, with minor changes, they are now in a final form and will be submitted to the Standards Committee for approval. These test methods are:

1. Dirt in Paper, T437.
2. Wire Side of Paper, T455.
3. Flexural Resistance and Deflection of Fiberboard for Bookbinding Use, T469.

Following are current projects under study by the committee:

1. Ink Erasing Quality of Paper, T478, Chairman, P. W. Codwise.
2. Wax Test for Surface Strength of Paper, T459, Chairman, B. L. Wehmhoff.
3. Thickness of Thin Paper, Chairman, P. F. Wehmer.
4. Bulk of Book Paper, Chairman, B. L. Wehmhoff.
5. Water Resistance of Paper and Paperboard (Dry-Indicator Method), T433, Chairman, D. H. Newcomb.
6. Turpentine Test for Grease Resistance of Paper, T454, Chairman, S. C. Fairbanks.

Chairman of the subcommittees on each of these projects reported on the progress of work under way. In all cases the projects are active but further studies are necessary before the test methods will be in a completed form and ready for

committee approval. Some changes will be made in various members serving on subcommittees of these projects.

There are 38 TAPPI Standards which come under the jurisdiction of the Paper Testing Committee. Each of these methods was completely reviewed with respect to status, date of last correction or revision, and probable importance of the test as to use. Based on this analysis six of these test methods were selected as future projects for the committee work. Subcommittees will be assigned to each.

Test methods selected were as follows:

1. Bursting Strength of Paper, T403.
2. Tensile Breaking Strength of Paper and Paperboard, T404.
3. Basis Weight of Paper and Paperboard, T410.
4. Water Absorption of Bibulous Paper, T432.
5. Air Resistance of Paper, T460.
6. Flammability of Treated Paper and Paperboard, T461.

W. P. Dohne, *Secretary*

Container Testing Committee

The Container Testing Committee was called to order at 10 : 30 a.m., Sept. 28, 1955, at the Sheraton-Kimball Hotel, Springfield, Mass., by M. Yezek, chairman. This meeting was held in conjunction with the Testing Division Conference.

Those present at the meeting were as follows:

K. Martin, Fort Wayne Corrugated Paper Co., Hartford City, Ind.
E. Knapp, Hinde & Dauch Paper Co., Sandusky, Ohio
W. F. Bachelder, Testing Machines, Inc., New York City
C. H. Root, Institute of Paper Chemistry, Appleton, Wis.
A. W. Hoffman, Robert Gair Co., Inc., New York City
E. Carpenter, Weston Paper & Mfg. Co., Terre Haute, Ind.
R. Scharmer, Stone Container Corp.
E. D. Kelly, Star Container Corp.
W. S. MacDonald, International Paper Co.
C. S. MacNair, Acme Steel Co., Chicago, Ill.
R. E. Swingle, Acme Steel Co., Chicago, Ill.
W. P. Stillman, Bird & Son, Inc., East Walpole, Mass.
H. S. Schlotter, Hoerner Boxes, Inc., Keokuk, Iowa
H. Seibel, Gaylord Container Corp., St. Louis, Mo.
E. Stephenson, Sutherland Paper Co., Kalamazoo, Mich.
H. G. Nelson, Owens-Illinois Glass Co., Toledo, Ohio
M. Yezek, General Foods Corp., Battle Creek, Mich.

A review was held on established objectives of the committee. The Container Testing Committee will follow through on completion of procedures for flat crush, compression, and burst tests. Every attempt will be made to complete these procedures by February, 1956; however, in those instances where tests must be performed to determine the reproducibility of the procedure, the completion date may have to be moved to the fall of 1956.

C. S. MacNair acted as secretary for this meeting in the absence of T. Muldoon.

It was moved, seconded, and agreed that the committee members be polled at the February, 1956, meeting to decide whether the Container Testing Committee will meet with the Testing Division next year or whether this committee should meet with packaging group conventions. The group present unanimously agreed that a vote should be held at the February TAPPI meeting to decide at which of the following conventions we would meet: (1) Packaging Institute; (2) TAPPI Corrugated Conference; (3) Materials Handling Show.

The next order of business was a review of the members of the committee and their assignments. It was voted that the secretary write to those members who failed to answer a post card inquiry to learn their intentions toward taking part in committee work.

Compression

Ked Martin, subcommittee chairman for compression procedure, reviewed the progress of his subcommittee. The ASTM D642–47 procedure was reviewed by the committee members and suggestions were submitted by the members toward improvement of the method. Points which require clarification follow:

1. Method of closure on a full overlap carton.
2. Method of closure on special design boxes.
3. A suggested standard speed at which the plater should move when making a compression test.
4. Preloading allowance on double wall containers or special design containers.
5. The degree of reproducibility which may be necessary before a test can be considered valid.

Flat Crush

The committee chairman covered committee progress on this project by reading correspondence.

Meeting of the Container Testing Committee during the Testing Conference

A questionnaire was submitted to the subcommittee membership asking for specific comments on the ASTM "Tentative Method of Test for Flat Crush of Corrugated Paper Board." The results of this questionnaire have been received but not analyzed.

Miscellaneous comments given from the floor on considerations which might be taken into account by the Flat Crush Subcommittee follow:

1. Mr. MacNair will provide a history of the subject from files of past work.
2. ASTM is restudying the procedure on flat crush; a questionnaire was sent out by ASTM; it was suggested that H. Nelson keep in contact with A. Lincoln on progress made by ASTM.
3. K. Martin suggested that procedure include testing of double wall board, if possible.
4. E. Knapp suggested that size of test specimen should be studied. Discussion showed that many different sizes and round and square specimens are being used.
5. It was suggested that procedure should have clear definition of end point. Nelson pointed out that he had had called to his attention that any changes in instrumentation governing flat crush should be scrutinized for possible effect on "Ring Crush" since in many instances the same instrument is used for both tests.

Mullen Test

In the absence of A. Grundy, subcommittee chairman for Mullen Test Procedure, the chairman reviewed Mullen test procedure progress by reading correspondence.

A meeting was held in Chicago on June 16, 1955, to review TAPPI Standard Method No. T 403 m-47. Agreement was reached that specific changes should be made to the present procedure.

The committee is considering high clamping pressures, 100 p.s.i. minimum, to attain more reproducible results. However, the committee realizes that those governing Rule 41

would have to be persuaded to change Mullen standards since such a change would reduce the bursting strength value of corrugated board. Otherwise, this change in procedure would place undue hardship on manufacturers of corrugated board.

Suggestions for the subcommittee to consider came from the floor and were as follows:

1. Mr. Root and Mr. Knapp suggested that rubber diaphragms be standardized and be made incorporating natural rubber rather than synthetic rubber.
2. It was suggested that foil be considered for standardization of diaphragms. Mr. Root reported that The Institute of Paper Chemistry had good results using "Pouncing Paper" for this purpose.
3. Canadian and German work on the Mullen test which is in committee files will be passed on to Mr. Grundy.

General

E. Stephenson asked for an appointment of a member of one committee to act as liaison between the Container Testing Committee and the Routine Control Methods Committee. H. J. Schlotter accepted this appointment and this position was titled subcommittee chairman, Routine Tests.

The Microscopy Committee at the Sixth Testing Conference

Since each test procedure with which our committee is working may require special study to determine reasons for variability and to determine reproducibility, it was suggested that subcommittee chairmen consider planned experiments designed to settle specific points relating to their procedure, poll their membership on whether or not they agree with TAPPI sponsoring the specific project, obtain bids for doing their specific job for two or three concerns and submit this total package to the committee chairman. This information will be passed on to the division chairman who in turn will pass it on to the Research Appropriations Committee, if it meets his approval. It is felt that such a plan would expedite development of a procedure and possibly would result in a more sound procedure.

Each subcommittee met on the afternoon of Sept. 28, 1955, to review their future plans.

C. S. MacNair, *Acting Secretary*

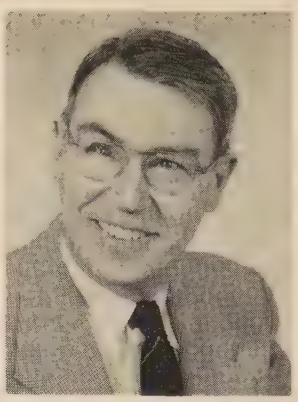
Microscopy Committee

A meeting of the Microscopy Committee was held on Sept. 28 and 29, 1955, at the Sheraton-Kimball Hotel, Springfield, Mass.

The following persons were in attendance:

* M. F. Wilson, Fonda Container Co., St. Albans, Vt.
* F. L. Simons, Crane & Co., Inc., Dalton, Mass.
W. A. Hasmer, Hurlbut Paper Co., South Lee, Mass.
R. H. Tompkins, Electrical Testing Labs., New York, N. Y.

M. Yezek, General Foods Corp.; Chairman, Container Testing Committee



I. H. Isenberg, The Institute of Paper Chemistry; Chairman, Microscopy Committee

* E. F. Barker, Oxford Miami Paper Co., West Carrollton, Ohio
E. C. Ladd, American Viscose Corp., Marcus Hook, Pa.
A. Dreich, Chicopee Mfg. Corp., Chicopee, Mass.
* D. A. Cameron, Alliance Paper Mills, Merritton, Ont., Canada
Bod Stoll, Eastman Kodak Co., Rochester, N. Y.
* R. H. Simmons, Government Printing Office, Washington, D. C.
* I. H. Isenberg, Institute of Paper Chemistry, Appleton, Wis.
Lloyd Shakley, J. A. Manning Paper Co., Green Island, N. Y.
H. Wright, Eastern Corp., Bangor, Me.
A. G. Lang, Champion Paper & Fibre Co., Hamilton, Ohio

* Committee members.

Morning of Wednesday, September 28

F. L. Simons of Crane & Co. presided. The committee discussed the proposed contents of the TAPPI monograph on Pulp and Paper Microscopy. Mr. Simons reported on progress made so far and made chapter assignments to various authors, some definite, some tentative.

Afternoon of Wednesday, September 28

I. H. Isenberg, Institute of Paper Chemistry, and regular chairman of this committee, presided. A brief discussion was held with K. H. Williams, chairman of Nonfibrous Materials Testing Committee, on writing a standard method on the morphological identification of starch.

The largest portion of the afternoon was spent in the discussion and revision of TAPPI Suggested Method T 445 sm-44 on the Identification of Specks and Spots in Paper.

Morning of Thursday, September 29

Mr. Isenberg presided. Revision of T 445 sm-44 was continued. The revision was tentatively completed, to be retyped and submitted to the committee membership for approval.

Ernest F. Barker, *Sec. Pro Tem*

41st Annual Meeting
of the
Technical Association
of the
Pulp and Paper Industry

Hotel Commodore, New York, N. Y.

Feb. 20–23, 1956

LOCAL SECTION ACTIVITIES

Reports of Meetings, Personnel, and Events

Ohio

The October meeting of the Ohio Section of TAPPI was held at the Manchester Hotel in Middletown, Ohio, Oct. 11, 1955. One hundred and forty-two members and guests registered for the dinner and meeting which followed.

The chairman, William H. Aiken called the meeting to order and proceeded to give a short history of the Ohio TAPPI, which celebrates its twentieth year this month. Mr. Aiken then introduced all the past chairmen.

Mr. Aiken then introduced R. G. Macdonald, national secretary of TAPPI who gave the group a little insight into the development of the Ohio Section.

Malcolm Lyons then announced the next meeting, which is to be a joint meeting with the Miami Valley Superintendents, on Nov. 17, 1955.

Harlan Vogel then introduced the speaker for the evening, Oscar Bizzell, chief of the Technical Developments Branch of the Isotopes Division of AEC.

The title of Mr. Bizzell's talk was "Production and Industrial Uses of Radioisotopes." The following is a brief résumé of Mr. Bizzell's talk.

Although it is possible to produce a wide variety of radioactive isotopes in the cyclotron, large-scale production has been possible only since the advent of the nuclear reactor. Radioisotopes are produced in nuclear reactors in two ways: (1) by fissioning or splitting of uranium atoms and (2) by bombarding ordinary stable elements with new neutrons.

The principles of use may be reduced to the following three. In the first the material is effected by the radiation, much the same as radium and x-ray machines are used. In the second mode, the material effects the radiation, as in the case of an x-ray wherein the material makes a shadow on the film. In the third mode, the radioisotopes serve as a tracer. This may then be put into a substance that is subjected to a long complicated process and can be traced quite easily.

Some of the industrial uses of the radioisotopes are as follows: (1) the reduction and elimination of static electricity through ionization; (2) thickness gaging meters through reflection of beta rays; (3) development of plastics through activation of chemical reactions; and (4) sterilization through gamma radiation. Extensive experimentation is being carried on in the food and drug industry.

Mr. Bizzell then gave a few examples of the possible future uses of radioisotopes. He suggested that one of the main uses might be as tracers, to follow the component parts of a product through its process.

Mr. Bizzell concluded by saying that radioisotopes hold the key to many present-day industrial problems.

The chairman, William Aiken, thanked the speaker for his interesting talk and adjourned the meeting.

Lake States

The purposes, organization, financial support, and facilities of five Scandinavian and European research and education institutions were described by scientists of Finland, Germany, Norway, and Sweden Thursday night, Sept. 15, 1955, to a capacity crowd of pulp and paper industry men.

The four speakers addressed the first meeting of the 1955–56 season for the Lake States Section of the Technical Association of the Pulp and Paper Industry (TAPPI) at the Conway hotel. Colored slides were used by all four speakers to describe their respective institutions.

The foreign research and educational leaders painted varied pictures of pulp and paper institutes organized much like Appleton's own Institute of Paper Chemistry, some dependent partially upon the governments of their countries, with generally similar goals and problems.

The speakers were introduced to TAPPI members by Harry F. Lewis, Institute of Paper Chemistry vice-president and chairman of the TAPPI Fundamental Research Committee since 1932.

Finland's pulp and paper institute is supported without exception by the 30 companies operating 72 mills in that northern land, TAPPI members were told by Charley Gustafsson, assistant managing director of the Central Laboratory of Finland, Helsinki.

The Finnish institute is in no way obligated to the Finnish government for supporting funds, Mr. Gustafsson said. The state does sponsor some students who come to the institute for periods of study, however, he added.

Periodic meetings are held in which the engineers and specialists working in the Finnish pulp and paper industry meet with the Central Laboratory staff to discuss problems and possible solutions. "All research is decided upon through these meetings," said Gustafsson.

The institution's own staff members also go into the field, visiting the mills to examine industry problems first hand, Gustafsson said, and in this way the research methods and solutions to problems are guided through practical experience.

As does the Institute of Paper Chemistry here, the Finnish institution performs special research projects for individual members on a private basis, with results reported only to the sponsoring company, Gustafsson noted. Other industry-wide sponsored projects are reported and published in technical journals.

The Finnish Central laboratory, under leadership of Walde-

The principal speakers at the Lake States Section meeting, Sept. 15, 1955: Mr. Loschbrandt, Prof. Jayme, Mr. Giertz, Mr. Lewis, and Mr. Jensen

Head table at Lake States Section meeting, Sept. 15, 1955: Mr. Harrison, Mr. Macdonald, Mr. Jensen, Prof. Jayme, Mr. Lewis, Mr. Parsons, Mr. Loschbrandt, Mr. Salverson, Mr. Giertz, and Mr. Hatch

mar Jensen, managing director, is organized much like other research institutions, with departments of inorganic chemistry, groundwood pulp, bleaching cellulose, cooking, testing laboratories, and the like. The Central Laboratory also makes periodic checks of Finland's large volume of exported pulp, through samples taken by employes at every export outlet.

Finland's institute is "now quite crowded," Gustafsson said, which was a view expressed by two of the other three speakers as well. The exception was Firthjof Loschbrandt, who showed slides of a new building into which the Norwegian Pulp and Paper Research Institute, Skoyen, is moving. The Norwegian school also has experienced crowding in recent years due to growth of research work, he said.

The Norwegian institute, founded in 1923, experienced rapid growth from its inception, with a slight setback during World War II, and became "terribly overcrowded" by 1953, when there were 75 or 80 research men at work.

The new building, begun 2 years ago, will relieve this problem and provide the Norwegian Pulp and Paper Research Institute with the largest of a series of new buildings planned around a central research hub, the Central Institute of Technological Research, with other plants for cement, wood technology, electrical technology, and the like.

Norway's new institute building may seem large for a nation with such a relatively small population, Loschbrandt observed, but explained the importance of pulp and paper in the nation's economy makes such a large institution vital for continued progress.

Mr. Loschbrandt showed several slides of the long, tall gray building housing the new quarters for the Norwegian Institute. The structure has a garage underground, large library and laboratory facilities, ranged along a central corridor, and attached shops. Fireproof portions of the building will be used for more hazardous types of testing.

Professor Georg Jayme, of the Institute of Cellulose Chemistry of Darmstadt, Germany, provided some of the evening's best humor with frequent descriptions of his encounters with architects who wished to remove trees near his office window, who designed a lecture theater projecting into noisy street traffic, and caused him other difficulties.

The Darmstadt institute was founded in 1908, and is a "strictly educational" institute, not an industry research type organization like others, Professor Jayme stated. Many paper industry engineers do come to Darmstadt for two terms of study and research in cellulose, he explained, but this type of study for them was additional to their basic studies.

All research work is performed in experiments directed toward master's and doctor's degrees for the students, of which there are "very many now," Professor Jayme said. Right now the enrollment is at an all time high, with some 55 working toward master and doctor degrees, he said.

Professor Jayme showed numerous pictures of the Darmstadt building, pointing with glee to a large, heavily foliaged chestnut tree standing alone on the corner where his office is located. He said he fought with the architects for some time in order to save the tree. He found it nice to have "something green" to look at while pondering weighty problems.

"Its been a fight all my life with architects," Professor Jayme explained, next displaying the special lecture theater with an archway over the street, in which he had special triple windows installed and other features, to make it soundproof. This too, was an architect's idea, he said.

Professor Jayme showed numerous slides of testing equipment, including several pieces of apparatus used to produce rayon, to finish, wash and dye it on a small scale. Several photographs showed some of the latest type of testing equipment developed by German industry.

Mr. Jayme also showed pictures of a paper chromatography laboratory and testing machines, a multiple cooker which can prepare 20 pulping samples in 2 hr., a rayon spinning machine, a wood collection, and views of long, modern laboratories with equipment and benches developed by the Darmstadt staff.

Hans W. Giertz, formerly of Swedish Forest Products Laboratory, Stockholm, and more recently associated with the Technical University of Norway, Trondheim, described both institutions in his talk.

The Swedish Forest Products Laboratory is intended to perform three functions: education, fundamental research, and applied research, Mr. Giertz said. The three units are housed in one unusual, cross-shaped building, but function nearly independently, with no over-all director, he said.

The laboratory receives much support from various branches of the Swedish government, education, for example, producing funds from the education department, and fundamental research obtaining aid from the department of commerce.

Administration and research programs at the laboratory are given a very free hand, Giertz added, and directors may choose their projects and methods almost entirely without supervision. Budgets are handled by each of the three departments.

The three branches cooperate in the one building on problems they are unable to solve within their own section, he said, having the advantage of being able to walk to another section and ask for technical advice.

The Swedish Forest Products Laboratory has a huge experimental paper machine, "said to be the largest and most expensive toy in the world," Mr. Giertz said as he showed slides of the big machine.

The machine is used to study what happens on a paper machine from the wet end to the final roll. The machine is run from pulp prepared in the laboratory, and can handle 1500 ft. on the wet section and 1000 ft. on the dry, he said. Pulp must be prepared for several days and stored before making test runs.

The Swedish laboratory has a staff of about 200 persons, which compares with about five of the larger industry-supported private research centers, with 50 to 100 staff members in their laboratories. The industry research plants concentrate on applied research, however, while the forest products laboratory is more interested in fundamental research, he said.

The Technical University of Norway at Trondheim is an old university, with facilities and a program of education and fundamental research in the various scientific subdivisions connected with the pulp and paper industry. This university now is undergoing expansion and new buildings are being erected to handle the growing divisions, he concluded.

Chesapeake & Allegheny Pulp & Paper Club

Paper mill instrumentation was the theme of the first meeting of the season for the Chesapeake & Allegheny Pulp &

Paper Club, held at the Hotel Jefferson, Richmond, Va., on September 23. Ben Cooper, of General Electric Co., at Waynesboro, Va., and Everett Swift, of the Foxboro Co., spoke to 40 members who were present. Albemarle Paper Co. won recognition as the organization having the largest delegation in attendance.

Mr. Cooper, speaking on the topic of automation, generally, emphasized that this recently controversial subject is really nothing revolutionary, but merely an evolutionary development in the continual mechanization and upgrading of labor in industry. Beginning with the "Industrial Revolution," we have progressed from hand tools through motor-driven tools and controlled motor-driven tools to mechanized steps in manufacturing processes. Prominent characteristics of "automation" are the increased use of indirect labor in the planning and set-up of operations, mechanical transfer of material and its positioning for operations, the combination of groups of machines, and the use of feedback control. If productivity is to increase 40% within 10 years, as predicted, automation will be essential to put increased power in each worker's hands. Mr. Cooper showed and described several applications of general interest, such as photoelectric relays for counting and height sensing, electronic motor controls on conveyors and drives, and machine tool controls by magnetic tapes and punched cards.

Mr. Swift explained the operation of the beta-ray profiler and showed how it is used for control of basis weight in the mill. Its distinctive characteristics are sensitivity to total weight of the paper, absence of contact with the sheet, continuous and averaging record, and safety. It is not sensitive to color. No personal injury resulting from its use has yet been reported. As it permits production with a much more uniform basis weight, there is a considerable economic saving whether the product is sold by area or by weight. There is a reduction of broke and tear-outs, and fewer rejections because of failure to meet specifications. Improved calendering and coating also result from the more uniform paper. The greater uniformity in basis weight is reflected in less variation of many properties of importance to customers, such as printability, fold, strength, tear, opacity, and stiffness.

Mr. Swift analyzed the factors affecting basis weight on the machine, including long-term effects such as caused by the stock gate, consistency drift, freeness, machine speed, moisture, and slice adjustment, and short-term factors like formation, cycling of the machine speed or of consistency, rotating parts, sticking valves, and surging in the flow box. He showed how the record of the beta-ray profiler could be used to locate sources of these effects. Mr. Swift also discussed briefly moisture controllers and magnetic flowmeters.

A spirited question-and-answer period followed the presentations.

R. B. Hobbs, *Vice Chairman*

Pacific Section

The Pacific Section of TAPPI met at the Winthrop Hotel, Tacoma, Wash., Sept. 29, 1955. The meeting was planned around the theme of "water" which is so vital to the industry. There were approximately 150 in attendance at the technical session.

The program began at 2:00 p.m. and S. P. Strayer, St. Regis Paper Co., Tacoma, Wash. served as moderator. The papers presented were as follows:

1. "Use of Various Flocculating Agents for Water Treatment," by Louis J. Kotnik and George Hansen, Weyerhaeuser Timber Co., Everett, Wash.
2. "Practical Condensate Corrosion Control," by Otto L. Hudrlik, The Flox Co., Portland, Ore.
3. "Re-use of Water in Pulp and Paper Mills," by Herman R. Amberg, West Coast Resident Engr., National Council for Stream Improvement, Engineering Experiment Station, Oregon State College, Corvallis, Ore.
4. Ketchikan Pulp Co. Water Storage and Treatment," by Roland J. Stanton, Ketchikan Pulp Co., Ketchikan, Alaska.

A social hour followed the technical meeting at 5:30 p.m. and dinner was served at 6:45 p.m. John McEwen, chairman of Pacific Section, introduced Georg Jayme, Director of the Institute of Cellulose Chemistry, Technical University, Darmstadt, Germany, who spoke on "Pulp and Paper Problems from an International Point of View."

Robert Smythe, *Secretary-Treasurer*

Use of Various Flocculating Agents for Water Treatment

L. J. Kotnik and G. A. Hansen

Everyone associated with the pulp and paper industry recognizes the importance of water to pulp and paper mills. Requirements vary from about 15,000 gal. per ton of unbleached board to about 100,000 gal. per ton of high grade bleached dissolving pulp. Pulp and paper people also recognize that this water must be of the highest quality, especially for bleached pulps, in order to attain products of the highest brightness and with a minimum of metals contamination. It is customary for pulp mills to obtain quality water either by processing it in their own filter plants or by purchasing it from existing municipal systems. At the Everett kraft mill of Weyerhaeuser Timber Co., we treat about 26 million gal. of water per day for a mill producing in excess of 300 tons of bleached market pulp per day.

There are three major factors involved in water purification: physical plant layout and equipment for processing the water, sanitation equipment to remove bacterial matter, and chemical flocculation agents to remove dirt and coloring matter. In a recent Shibley Award paper (*1*), D. K. Wooden of the Weyerhaeuser Timber Co. engineering staff outlined in detail the physical features of our filter plant. We will not, therefore, discuss this phase of water treatment in this paper except for two things. We wish to point out that the hydraulic mixing technique employed appears to give us superior water treating conditions that make possible operating economies not found with other flocculating systems. The second point is to show the water and chemical flow of our filter plant.

Figure 1 shows a diagrammatic sketch of the water and chemical flow in the filter plant. As can be seen the alkaline agent is added first, right before the water enters the first mixing chamber. Alum is added as the water leaves no. 1 mixing chamber and the chlorine enters just ahead of the second chamber. There is a retention time in each mixing chamber of about 10 min. From the no. 2 chamber it travels to the flocculating chambers where it spends about 20 min. forming the floc. From the flocculators, the water passes to the settling basins where the floc spends 2 hr. increasing in size and settling. Filtering follows and takes about 20 min. Thus the water takes about 3 hr. to travel through the complete plant.

As mentioned earlier, our second objective in this plant is sanitation which is achieved with a standard chlorine injection system. By carrying a residual chlorine level of about 0.4 p.p.m. in our filtered water we maintain drinking water purity without the addition of copper sulphate or other slime control chemicals. By maintaining this chlorine level continuously from our first day of operation, we have successfully prevented slime growth at any point in our stock system with an average chlorine demand of about 14 lb. per million gal. of water (0.1 grain per gal.).

That brings us to the third area of water processing, viz., chemical flocculation of coloring matter and suspended dirt. This is the principal area we wish to discuss.

Before mentioning the possible choices of chemical systems it should be mentioned that all our feed equipment, viz.,

L. J. Kotnik, Project Chemist, and G. A. Hansen, Chief Chemist, Pulp Div., Weyerhaeuser Timber Co., Everett, Wash.

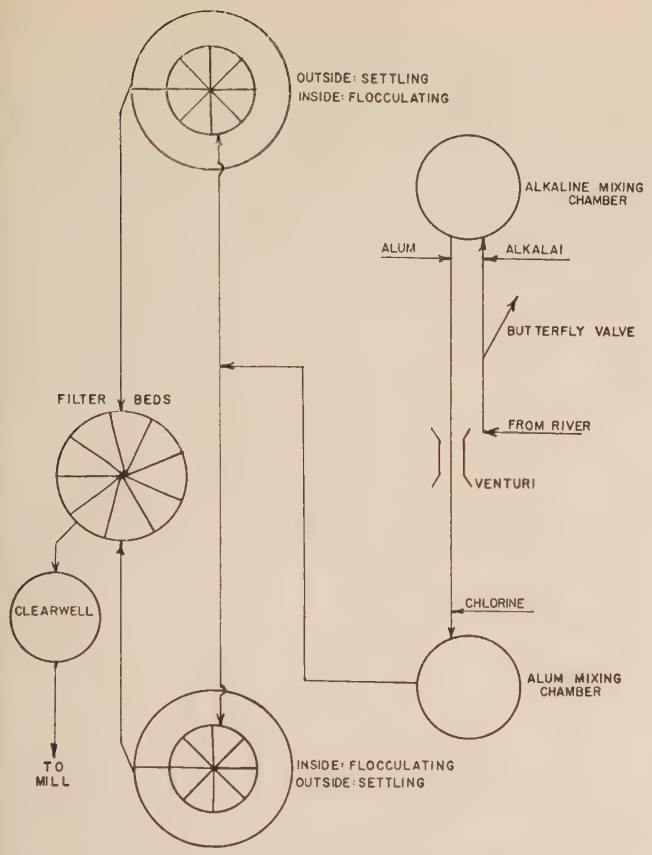


Fig. 1. Water flow diagram of filter plant

alum, alkaline chemical, and chlorine, are controlled by a venturi flow system (Fig. 1). In addition, it should be pointed out that our unique mixing and flocculating system enables us to remove all dirt and color even under the most adverse conditions such as cold water (33°F.) and low turbidity (1 p.p.m.). Original studies of our color removal problem (5 to 80 p.p.m. covers our normal range) indicated we might have difficulty but we readily achieved complete removal of color from the start with all chemical combinations tried in our plant. At the present time the common flocculating systems include iron salts-alum, lime-alum, sodium aluminate-alum, sodium hydroxide-alum, and silica-alum (*2*). Iron salts were not studied because of the necessity for low iron residuals in our pulp and in our boiler water. The silica-alum system was investigated insofar as the "jar test" was concerned and proved to be promising. The floc produced from this combination seems to be larger and faster-forming than the others investigated. However, plant studies will have to wait until the necessary temporary equipment is installed. Thus our main efforts to date have been directed towards evaluating various combinations of alum with lime, caustic, or sodium aluminate.

PROCEDURE AND RESULTS

Along with the plant studies, jar tests were run periodically with each of our coagulating systems. These were run in the following fashion using a six-unit synchronized stirrer with tachometer: (1) 380 ml. of the raw water was placed into a beaker; (2) the proper amount of alkaline reagent was added; (3) the agitators were lowered into the water and started at 100 r.p.m.; (4) the alum was added; (5) the various solutions were agitated at 100 r.p.m. for 2 min., 80 for 2 min., 60 for 2 more, and at 40 r.p.m. for 9 more min.; (6) each jar was then graded for the floc formed.

This procedure roughly simulates the plant system of chemical addition, mixing, and flocculation. That this is only an approximation is attested to by the fact that in all cases the plant addition of chemicals was somewhat different than that shown by the jar tests (Table I).

As can be seen in the lime-alum system actual practice dictated larger feeds than the jar tests indicated, in sodium aluminate slightly lower, and with caustic, higher in sodium hydroxide but lower in alum.

In running the actual plant tests the chemical feeds were set at figures that indicated a substantial floc by the jar test. This was allowed to run for about a day. The alum feed was then lowered, perhaps 0.1 grain per gal. The alkaline agent was lowered simultaneously to keep an optimum treated water pH of 6.7 to 6.9. This dosage was run for about 24 hr. and the alum and basic reagent were lowered again. Gradual reduction was continued until the floc was lost as in the case of the lime-alum and caustic-alum systems or when the floc was so small that too great a quantity of it flowed over the settling basin weir and lowered the filtering rate of the filters too rapidly. The latter point was reached when the sodium aluminate-alum systems were investigated.

After determining the minimum feed, the filter plant then was run for several days under these conditions and the loss of head of the filters was determined. We then essentially had a measure of the lowering of the filtering rate. Table II shows the results of these tests. The costs which are tabulated in the last column at the right were based on prices current on Sept. 1, 1955, and with our original lime-alum feed as 100%.

It can be noted that in this series of tests, the incoming water turbidities were lower but the color higher than in the original studies in August and September of 1954. It also can be noted that in all cases our chemical feeds were lower in this series than in 1954. Actually this has been our first opportunity to establish minimum feeds of all these chemical systems. These tests had to be run when the turbidity and color were relatively low and unvarying. They had to be relatively consistent to get a true comparison and low so that if we were to lose the floc for a few hours, not too much damage would be done to the water and consequently to the pulp and powerhouse.

Again, turning to the last column on the right we can note that the flocculating cost of both the sodium hydroxide-alum and sodium aluminate-alum were about 40% of the original figure, indicating a substantial saving. It would appear on the surface that the sodium aluminate-alum combination would be somewhat cheaper than the caustic-alum one. The only reason for the difference between the two aluminate tests (each was made with aluminate from a different manufacturer) is that the feed systems were difficult to regulate at these low feeds of, e.g., 115 to 130 grams per min. sodium aluminate and 250 ml. per min. alum. On the aluminate feed in both cases we went as low as the equipment would permit us. More on this comparison in a moment.

Turning to the second column from the right we can see a measure of filter bed head loss in feet per hour per bed. This, in essence, is a measure of the loss in filtering capacity of the filter beds. Actually, the only thing that has to be worried about here is if the filters dirty faster than they can be cleaned. In no case was this true. Although in some cases, notably that of the caustic-alum and second aluminate-alum, the loss in head did increase materially, the latter case quite significantly.

Table I

	Jar test		*Plant operation*	
Alk. ag.	*Alkali, gr./gal.*	*Alum, gr./gal.*	*Alkali gr./gal.*	*Alum, gr./ gal.*
Lime	0.2	0.5	0.3	0.73
Sodium aluminate (B)	0.15	0.15	0.10	0.14
Sodium aluminate (A)	0.15	0.15	0.11	0.14
Sodium hydroxide	0.08	0.4	0.17	0.36

Table II

Date	Alkali flocculating agent	Water, gal./day	Incoming water: Turbidity, p.p.m.	Incoming water: Color, p.p.m.	Alum: Grains/gal.	Alum: Lb./million gal.	Alkali floc agent: Grains/gal.	Alkali floc agent: Lb./million gals.	Clearwell: Turbidity, p.p.m.	Clearwell: Color, p.p.m.	Filter bed loss head, ft./hr./filter	Cost, % basis
Aug. 18, 1954	Lime	20.5	4.5	6	1.2	171.4	0.35	50	0	0	1.56	100
Sept. 13, 1954	(A) sodium aluminate	25.9	5	9	0.5	71.4	0.15	21.4	0	0	1.77	76.7
Aug. 4, 1955	Lime	24.7	3.1	23	0.73	104.9	0.30	42.4	0	1	1.36	83.3
Aug. 17, 1955	(A) sodium aluminate	25.0	0.9	19	0.14	20.0	0.11	15.9	0	0	1.61	40.5
Aug. 25, 1955	Sodium hydroxide	24.7	1.1	18	0.36	51.8	0.17	24.6	0	0	2.29	40.0
Sept. 3, 1955	(B) sodium aluminate	23.9	1.2	15	0.14	20.6	0.10	13.7	0	2	2.72	37.1
Aug. 11, 1955	(B) sodium aluminate	24.8	2.0	20	0.13	19.0	0.13	18.2	0	0	2.29	45.4

However, as was said, the loss in head did not cause a problem at least at the feeds cited in this report. It takes about 40 min. to backwash a filter. Although this is not a determining factor in our case, water usage is, i.e., when water use is high in the mill there might not be sufficient water left to backwash the filters often enough. However, each of our filters needed to be washed only once each 24 hr. under the greatest loss of head encountered, which is adequate under our present conditions of water demand.

In our filter plant, the sodium hydroxide-alum and aluminate-alum systems are approximately the same in cost, and both are much less than the lime-alum (about 40%). Even though the apparent chemical cost of the sodium aluminate flocculating system is slightly cheaper than the caustic, in the long run it would probably prove to be higher for two reasons. The first, the aluminate is in solid form and requires handling costs at the mill while the liquid caustic is gravity fed from a constant head, automatic, bleach plant make-up tank which needs no handling. Secondly, maintenance costs on the mechanical, dry-chemical feed system is much higher than that for metering liquid caustic. So it can be seen that the sodium hydroxide-alum combination is the most attractive for us. Another point to mention is that the supply is more readily available since caustic is used in large quantities in the mill bleach plant.

However, in case of emergency, we can readily switch to either of the dry chemical and alum systems. We intend using lime and alum as a standby rather than the cheaper aluminate. Lime in sacks keeps better because it doesn't tend to pick up as much moisture and ball up. Properly packaged, sodium aluminate remains free-flowing many months, but it would be questionable whether it would last years on a standby basis.

One further advantage of the caustic and aluminate systems over lime is that they have less hardness which is beneficial for boiler water treatment. Some savings can be realized because the zeolite water softeners (for boiler water) will not have to be regenerated as often.

CONCLUSIONS

To summarize, it can be seen that in our case, the caustic and alum combination is the most practical for our water plant. At some other location with different price differentials some other system may be cheaper. For example, if sodium aluminate could be shipped in liquid form at a lower cost than the solid form, it could well change our economic picture. Since sodium aluminate is a relatively expensive chemical, price changes here are quickly reflected in water processing costs. Price changes in any of these chemicals could affect our decision from day-to-day. However, in the final analysis, a series of tests would have to be run at each individual filter plant to determine the best system for that plant. Substantially, what we have done is to present a plan to evaluate different flocculating chemicals in a filter plant, showing possible approaches and factors to examine.

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Practical Condensate Corrosion Control

O. L. Hudrlik

The cost of corrosion in this country has been reported as $5^1/_2$ billion dollars a year (*1*). As a matter of interest, this would replace the entire pulp and paper producing capacity in the Pacific Northwest each 4 months. Regardless of what we think of the accuracy of this, we might feel that plant management and engineering personnel have put in something like that many hours planning ways to stop corrosion. Although condensate corrosion is a small part of the total, pipe fitters probably feel they have produced over $5^1/_2$ billion drops of sweat changing nipples and piping in the most impossible and inaccessible places.

Corrosion can be defined as metal being dissolved. When this happens in piping, these pipes hold water about as well as a tent made of mosquito netting. Corrosion not only causes loss of metal, followed by replacement, rust deposits, impaired heat transfer, and outages; but also there have been power outages because of magnetic iron oxide deposits in the boilers (*2*). In a modern high pressure steam generator a very small amount of iron oxide may cause hard deposits at critical points.

The causes of corrosion are about as numerous and varied as all of the conditions covering the entire subject of chemistry. In condensate systems of the Pacific Northwest, the important causes are: first, water, preferably hot because the reaction rate doubles with each 20° rise in temperature. For practical reasons all of the possible corrosion never takes place, the water is always hungry. The second cause is the presence of a material which removes the natural protective film from the metal, such as a high flow rate which scours or blasts the surface clean. Steam piping is designed for flow rates of 60 to 100 m.p.h. and velocity through restrictions and around bends is higher than that. Carbon dioxide combines with water, forming carbonic acid to dissolve the protective film, and metal surface.

In the area it is quite likely that these conditions would account for over 90% of all corrosion in condensate systems. There may be some argument for the advocates of oxygen corrosion, but in a properly operated system it is still quite easy to have 5 p.p.m., of carbon dioxide present in the steam, but it is just as likely that we will have 0.005 p.p.m. of oxygen. The ratio of CO_2 to O_2 comes out to be 1000 to 1, so it can be seen that the oxygen will not generally be too

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much of a factor. Oxygen is exceedingly serious when it is present in substantial amounts, but pound for pound it will not remove any more iron than carbon dioxide will. Like oxygen, hydrogen sulphide, ammonia, and sulphur dioxide are very minor in this area and can generally be neglected as serious contributors to condensate line corrosion.

Much as we would like a simple snappy answer, uncomplicated by details, this is not possible any more than it is possible to learn to make paper in one easy lesson. Since a typical raw water in this area has a free and combined carbon dioxide content up to 50 p.p.m. and an oxygen content up to 14 p.p.m. the potential corrosion in modern high speed equipment can be quite serious. In the raw water, solids are present which inhibit the action of corrosive materials, but a properly designed boiler is a very effective separator and permits the corrosive gases to go out with the steam and holds all the other solids in the boiler. So to inhibit corrosion in the condensate system adequate pretreating, softening, and deaerating equipment is installed to bring these two constituents down to a minimum amount which usually comes to a value of about 5 p.p.m. of carbon dioxide and 0.005 p.p.m. of oxygen (*3*). It is very seldom that chemical addition can economically take the place of equipment. Conner and Hanlon (*4*) discuss the various pretreating methods. An essential part of this is a deaerating heater which is, substantially, a very ingenious three-stage countercurrent gas removal apparatus consisting of first, a steam atomizer; second, a water atomizer; and third, a vent condenser to condense and trap the noncondensable gases. There are a number of deaerating heater types and most of them do excellent work.

Since about 1940 to 1945, improved types of feedwater pretreating plants have been developed and the use of volatile amines and film forming chemicals has been instituted for corrosion control. Previously, numerous people had tried boiler water blowback, organics, caustic, and phosphate. Although these helped, it was always found that there were difficulties such as deposits, poor distribution, and very spotty corrosion control. Occasionally a plant intentionally used oil in the steam, or was accidentally provided oily steam (*5*). Generally this made the condensate unfit for further use, or special treatment of the condensate was necessary to make it usable. Without adequate knowledge of proper handling of this condensate, it was often a case of jumping from the frying pan into the fire as far as boiler operation was concerned.

Volatile amines have been discussed in a number of publications, the most complete of which is by Berk and Nygon (*6*). Volatile amines have the property of vaporizing with so that excellent distribution is obtained in the entire steam system. They can be fed into the feedwater, directly to the boiler, or into the steam going to a special part of the process. It is only essential that the feed be continuous and correctly controlled.

Volatile amines are alkaline materials which neutralize the carbon dioxide present in the steam, and by increasing the alkalinity and pH of the condensate encourage the metal to form on itself a tightly adherent monomolecular protective film. This is essential because any successful method of corrosion control must set up conditions where a continuous protective film is formed on the metal by some method.

Results can be checked by examination of test strips, pipe nipples, or examination of the system, but day-to-day control is exercised by means of simple pH tests made on the steam or condensate. This test is very sensitive and very responsive to changes which occur in the system. Because the volatile amines are recycled from the boilers and recirculated through the system over and over, their use is most economical and practical for high pressure plants where every effort is made to reduce the amount of make-up and where it is necessary to provide the best possible pretreatment for the feedwater in any event.

Where high make-up requirements, or high alkalinity make-up waters are used with no pretreatment, it is more practical to use another type of material usually referred to as polar film-forming chemicals. These film forming materials are usually high molecular weight organic compounds that have the property of being carried by the steam and forming an adherent film on the steam and condensate lines. These materials are usually not truly volatile and should be fed directly into the steam lines. The film so formed prevents corrosion because it does not permit the condensate containing carbon dioxide and oxygen to come into contact with the metal (*7*). Naturally this is a long sought answer for the plants where they have had the most severe condensate corrosion problems. Results have been sufficiently good and the materials have been used sufficiently long that there is no question of their usefulness. They are used in many other applications for corrosion control under highly acid conditions, sometimes without neutralization, but more often in conjunction with it. Their use is controlled by examination of test coupons or pipe nipples.

All materials have their limitations, no material is a cure-all. For example, although caustic soda is a better material for raising pH than volatile amines it is limited by the fact that it will not vaporize at the temperatures at which water boils. In a similar way, the film-forming materials are limited by certain factors. The first is that although to a large extent they will be carried along by the steam, they are not truly volatile. In large systems the film-forming chemical drops out before the end of the system, and incomplete protection is obtained. A substantial amount of it may get to the boiler from the condensate. It then can cause results similar to oil in making sticky sludge, organic deposits, and carryover from the boiler. Powell states, "Recently filming-type amines have been developed which can be applied in much the same manner as the oil. These are waxy materials which provide a protective film on the metal surfaces. In a number of low-pressure installations, with which the author is associated, the filming compounds give favorable results. Recent experience at one plant has shown that some of these waxy materials, when present in condensate added to the boiler feedwater, have baked onto the tubes, resulting in overheating of the metal. Careful evaluation of the use of these compounds is required where there is a possibility of contaminating process steam or steam which comes directly into contact with food products. Here again the filming compounds must be added continuously at a rate sufficient to mend any damage in the protective film. Otherwise accelerated corrosion will occur on unprotected areas" (*8*).

In locations were superheat occurs it should be used cautiously because chemical breakdown may occur. Feed should be to the steam line—after turbines or pressure reducing valves.

Although ammonia has been used for corrosion control, its condensation characteristics are such that very erratic results are obtained. Low pH may result in iron solution in one part of the system, while high pH and copper corrosion form in another part of the system. Further corrosion then results both in iron and in copper or copper alloys, by complex electrolytic corrosion where deposits form.

Wherever corrosion takes place, there is naturally some deposit formed and this deposit retards heat transfer. Occasionally there is oil in the system which causes these deposits to build up and be held in one place. Use of the proper steam conditioning material will remove these deposits so that heat transfer can be improved. Heat transfer rates in B.t.u. per square foot per foot thickness per degree F. for various materials are as follows:

Copper	215
Brass	63
Steel	26
Water	0.395
Paraffin	0.130

Beeswax	0.019
Octane	0.083
Oils	0.079 to 0.1
Carbon dioxide	0.008
Steam	0.0182

It is expected that removing deposits would improve the heat transfer rate. Since water is a better conductor of heat than organic compounds in available information, every effort should be made to keep all metal surfaces completely clean. The presence of any oily material will retard head transfer even in very thin layers.

Another serious offender in retarding the rate of heat transfer is carbon dioxide gas which can accumulate in closed vessels such as heaters, heat exchangers, and driers up to concentrations on the order of thousands of parts per million by fractionation. The improved heat transfer rate on clean surfaces is probably more affected by the neutralization of carbon dioxide by volatile amines than by any other single factor. Improved heat transfer rates have been reported in a number of instances, at least one of which we felt was uncomplicated by other factors.

No discussion would be complete without a word about the seriousness of contamination in pulp and paper mill condensate systems. In the opinion of the water treatment specialist, no mill has enough equipment for contamination control and testing of condensate. When we consider in the case of indirect cooking of digesters for example that only 20% of the solids in black liquor will affect a conductivity meter, and we want to keep total contamination in the condensate below 1 or 2 p.p.m., measuring this contamination is difficult. This is further complicated by the fact that nearly all condensate already has about 1 p.p.m. solids in it. Further, when volatile amines are added they increase the solids in the steam, and when film formers are added, they coat the electrodes and reduce the apparent conductivity.

In summary:

1. The best possible boiler feedwater pretreating plant is essential.

2. Everything which happens in the boiler-steam-condensate-feedwater system affects condensate corrosion one way or another.

3. Mechanical factors have a direct effect on condensate corrosion (*9*).

4. Volatile amines, and film formers have been found to provide a large part of the much needed answer in corrosion control. Each has its own distinct application and in most cases they are not interchangeable (*10*).

5. Minute amounts of contamination in condensate can upset the most complete calculations.

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Re-Use of Water in Pulp and Paper Mills

Herman R. Amberg

WATER is a primary raw material in pulp and papermaking. The pulp and paper industry is the fifth industry in magnitude of water usage, using about 4 b.g.d. In the Pacific Northwest, the pulp and paper industry probably ranks second in water usage.

The Truman Materials Policy Commission estimated that by 1975 the United States may be using as much as 90% of all the water that can be developed at reasonable cost. The commission estimated that between 1950 and 1975 the total United States demand for water may nearly double—over 85% of the new demand presumably coming from industry and cities.

The demand for industrial water in the Pacific Northwest probably will more than double in the next 20 years. Surprising as it may seem, the West is much closer to the estimated limits of its potentially available supply than the East. Owing to irrigation losses, the West's consumptive use of 50 b.g.d. is over seven times that of the East. About two thirds of the West's average runoff of 350 b.g.d. is concentrated in the Pacific Northwest.

Most of the great western dams built in this century have had two primary purposes: (1) to provide water for irrigation, and (2) to control floods. Power, of course, is a welcome bonus. It is now becoming apparent that industry's needs for water should be given as high a priority as agriculture's, particularly since irrigation represents a relatively uneconomic use of water. Manufacturing produces about 50 times as much product value per gallon of water withdrawn as irrigation. It is also becoming evident that there is no practical way to control extraordinary floods.

In the over-all planning of basin water control, industry should be given adequate consideration and industry should take an active part in the planning stages. Sufficient water should be allocated for process water demands, present and future, and also for pollution control.

In many locations in the Pacific Northwest, the water supply is unlimited. There are many undeveloped regions, however, which have an abundance of pulpwood but have a limited water supply. In some locations expansion programs are definitely limited because of the high cost of obtaining sufficient quantities of water.

Since water treatment is becoming more costly, and since the supply of water is limited, re-use of water is essential in many critical areas.

Present emphasis on pollution control and treatment of effluents also has been a factor in reducing water usage. Where mills are faced with a treatment problem, reduction in volume of process waters is essential. In some instances re-use does not materially decrease the pollution load, but it does decrease the volume to be treated with a subsequent decrease in size of waste treatment facilities.

Re-use of water is complicated by many factors that differ from mill to mill. The degree of re-use is controlled primarily by economic factors. For example, too tightly closed recirculation systems may lead to troubles such as sliming, reduced machine speeds and production, reduced product quality, sizing difficulties, foaming, and equipment corrosion.

The greatest volume of re-usable process water in the mills is white water. In many paper mills, and particularly board mills, white water is re-circulated and there are a number of mills reporting closed systems. There are, however, serious limitations to the extent of re-use of white water in the paper mill. The type of product limits the degree of re-circulation. A high degree of re-circulation results in the buildup of dissolved contaminants which may cause serious operational

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difficulties. With certain changes in the system, however, it is possible to materially reduce water consumption by the re-use of white waters in the paper mill.

White water also is being extensively used to wash pulp in the sulphite and kraft mills.

One of the problems associated with sulphite pulping, which is directly tied in with water reduction, is liquor collection. For example, as the percentage of total solids which must be recovered increases, the problems connected with recovery also increase. About 50% of the liquor can be collected practically undiluted from the ordinary blow pit, and up to 70% is not too difficult if certain reasonable precautions are taken. When pollution abatement requires collection of a higher percentage, however, the collection problem becomes more involved. By padding the pits with strong liquor and washing the pulp with weak liquor, fresh water usage can be decreased and collection of solids can be increased without serious dillution. Several mills using blow pit washing report recoveries as high as 80% at 10% solids.

In mills where the recovery of liquor from the pits is unsatisfactory either because of stream pollution or the need for chemical recovery, a more costly means of recovery must be employed. Two very different types of equipment are possible—vacuum washers and screw presses. This equipment will recover up to 95% of the solids at dilutions of about 2 lb. of water per lb. of pulp.

Probably the greatest reductions in water usage have been effected by the kraft industry. Available data (*1*) show that present-day kraft pulp and paper mills are capable of operating successfully utilizing 20,000 to 30,000 gal. of water per ton of pulp. In these mills fiber losses range from 0.5 to 1.5%, with B.O.D. loads in the range of 20 to 30 lb. per ton of product. The use of vacuum filter brown stock washers has resulted in a closed system with no sewer discharge, less dilution of black liquor, and lower heat losses. New process equipment has been effective in reducing the water usage in the kraft mill.

In some mills re-use of condensates is a practice or is being contemplated. Re-use of the condensates high in organic content, where the possibility of destroying the organic content is the greatest, would reduce materially the pollutional characteristics and B.O.D. load of the mill. In a modern, unbleached kraft mill, the combined condensates will contribute about 60 to 70% of the B.O.D. load discharged, and will contain the major portion of the compounds potentially lethal to aquatic life. The digester relief condensate and the condensed vapors from the sixth effect are probably the most objectionable of the condensates and, therefore, should be re-used where the possibility of destroying its organic content is greatest. McDermott (*2*) has suggested that the re-use of these condensates on the lime mud filters would result in about 28% of the condensates being carried to the lime kiln. The condensate in the steam chest of the first effect of the evaporators is commonly returned to boiler feed. It is estimated that the major portion of condensates could be re-used in the mill.

Through efficient water usage, the water requirements per ton of pulp and paper will continuously decrease over the next 20 years. Although our production will double, the decrease in water usage per ton of product through re-use of water and development of new process equipment will ensure an adequate supply of water, and will make available many mill sites which have been by-passed.

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Ketchikan Pulp Co. Water Storage and Treatment

Roland J. Stanton

The Ketchikan Pulp Co. uses 30 million gal. of high quality treated water and another 14 million gal. of untreated water per day. The production of dissolving pulp requires water with low color, low metals, and low total hardness.

At Ketchikan the water is stored behind a 50-ft. concrete gravity section dam and conveyed through a wood stave pipeline for 3 miles to the treatment plant. At the treatment plant the "treated" water is chlorinated, treated with alum and sodium aluminate, settled and filtered through rapid sand filters. The remainder of the water is chlorinated and filtered for use in barking, screening, and acid making.

The Ketchikan Pulp Co. has a water shed area of 13.2 sq. miles above the storage dam. The water shed is mostly covered by heavy timber and muskeg swamps. This type of water shed produces a highly colored water with from 30 to 60 p.p.m. of organic coloring matter and turbidity of less than 1 p.p.m. There is very little seasonal variation in color with the exception of late summer algae growth which can double the color during warm dry periods.

The average rainfall in Ketchikan is 150 in. per yr. Normally, the driest months of the year are July, August, and September. The storage lake behind the 50-ft. dam holds 60 days' supply of water and there is some runoff from snow during the summer months. For example, in August and September of 1954 a 50-day dry spell used only one third of the stored water.

For most of the year the lake behind the dam is stratified. Since there is a multiple intake which allows water to be drawn from any level in the lake, we draw water from the best level for low color. By controlling a blow-off valve at the bottom of the dam during periods of excess water, water can be spilled from the lowest quality level. This practice substantially up-grades the water supply.

The total hardness of the raw water runs between 4 and 6 p.p.m. the year around. The iron concentration is about 0.2 p.p.m. with most of the iron associated with the colored matter. Silica concentration runs between 1.0 and 1.6 p.p.m. Water temperature varies from 2°C. in the winter to a late summer maximum of 14°C.

The water storage reservoir was first flooded in the fall of 1953. Most of the newly flooded area behind the dam was not cleared of trees and brush so a great deal of decaying vegetable matter has been available for algae growth. In warm dry weather such as occurred in September of 1954 algae multiplies very rapidly and can double the color in 2 weeks' time. Since copper is undesirable in dissolving pulp, normal copper sulphate algae control methods cannot be used. With the first day of cloudy weather, after a period of sunshine, the algae sinks to the bottom of the lake and the color drops sharply.

A three-mile 60-in. pentachlorophenol-treated wood stave pipeline is used to transport water from the dam to the mill. No pumping is required with the pipeline down grade all the way. There are two concrete lined tunnels and several vents and a vacuum breaker on the line. The last half mile of the line is 48 in. and banded for higher pressure. Wooden pipe was used to avoid the iron contamination of steel pipe. The 50-ft. head of pressure at the dam is not used and the water is throttled into an open forebay. The forebay level is controlled and the level is transmitted to the power house at the mill for recording with limit alarms. There is normally no one at the dam, although twice weekly equipment and sampling checks are made by the water system supervisor.

All the water enters the treatment plant and is screened through a 4-mesh Rex traveling screen. The traveling screen

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is cleaned once a day and seldom has more than 1 lb. of fish and trash on it. Directly behind the traveling screen the water flow splits, with 14 million gal. going to the untreated filters. This water is chlorinated to a residual of about 0.3 p.p.m. for algae control. Lime is added to the untreated water as pH corrective and corrosion inhibitor. The water is then filtered through rapid sand filters which remove algae, small fish and suspended organic matter. These filters need backwashing about twice a week except that during high algae periods they may need washing as often as every 6 hr. The untreated water is stored in a clearwell prior to its use in the mill for the hydraulic barking plant, acid making, unbleached pulp screening and the fire system.

Sodium aluminate fed from a Wallace & Tiernan dry chemical feeder is dissolved in a stainless steel pot with warm water and the solution is then fed into the water together with sufficient chlorine to give a residual in the clearwell of 0.2 p.p.m. The water then passes into a large mixing chamber where the chemicals are mixed by the turbulent flow of the water. Alum is then added to the water through another dry feeder with solution pot and the water is mixed again in another chamber. The water then flows through a bank of mixing elbows which gradually slow the flow and allow the floc to grow. From the mixing elbows the water goes through vertical venturi slots into three large settling basins where it is held for 3 hr. for the floc to settle. From the settling basins the water flows over skimming weirs to rapid sand filters and then to a million-gallon clearwell.

This treatment plant has two pumps for chemical feeders and general service water, a booster pump for high pressure water for the Wallace & Tiernan chlorine feeders, and one large backwash pump. All other flows are gravity and there are no mechanical mixers. The treatment plant is located on a hill above the mill, which permits the use of much of the water without booster pumps.

The treated water filters are backwashed every 2 days. For the first several months of operation an increase in color came at the start of washing these filters. The color came through only immediately after the first filter was washed. This coincided with the increase in rate of flow through the filters to supply backwashing water. The floc produced in Ketchikan water is so tender that it can be drawn through the sand filters by any rapid rate increase. The problem was solved by restricting the instrument air flow to the "rate of flow" controllers so that no sharp changes in flow were possible.

The treatment plant is entirely automatic with only one operator required on day shift 7 days a week to add chemicals to the feed hoppers, clean the feeders, and inspect equipment.

The settling basins are cleaned once a month by draining and washing with fire hoses. The cleaning can be done by the operator who cleans one basin a day with no reduction in water quality. During cleaning of a basin the plant runs on two settling basins with some floc carryover but the filters remove the additional floc for the short settling basin wash periods.

Water temperatures as low as 2°C. do not greatly reduce the rate of floc settling in the settling basins but do reduce the rate of solution of chemicals and of floc formation. During cold winter weather steam was added to the chemical solution pots to completely dissolve the chemicals before addition to the water. The improvement in the rate of floc formation was so great that steam is now used the year around.

The treatment plant was started and run for 5 months with lime and alum for treatment chemicals. This treatment produced adequate water in all respects except that the calcium hardness was high. Sodium aluminate and alum treatment was tried with excellent results and aluminate has been in use since that time. Aluminate and alum treatment is easy to control, easy to feed, and the cost is essentially the same as lime and alum treatment.

The optimum pH for flocculating has been found to be 5.2 the year around. The chemical feed of 0.5 gr. per gal. alum and 0.2 gr. per gal. sodium aluminate produces water with a color of 1 to 2 p.p.m. with raw water color ranging from 20 to 90 p.p.m. Nearly all the iron is removed, with less than 0.02 p.p.m. iron remaining in the finished water. Copper, silica and hardness are unaffected by treatment and run 0.01 p.p.m. copper, 1.0 to 1.6 p.p.m. silica, and 4 to 6 p.p.m. hardness.

After treatment, the water has caustic added to it to adjust the pH to about 6.8 for corrosion control and is carried to the mill in a wooden pipe. Throughout the mill all process waters are carried in stainless steel pipe to avoid iron pickup.

Presented at the meeting of the Pacific Section of the Technical Association of the Pulp and Paper Industry, Tacoma, Wash., Sept. 29, 1955.

EMPLOYMENT SERVICE

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P499-55. Chemist or Chemical Engineer. We want a man with experience in stock preparation and paper fiber utilization for Research and Production Control Laboratory supervision. Expanding company and leader in their field; excellent opportunities for advancement; present location in Western New England.
Desire person capable of supervising a research program, as well as developing production control and quality control techniques on paper products.
Give full details of education, experience, salary, references, and availability. All inquiries will be kept confidential.

P500-55. Wanted. Project manager to supervise construction of large pulp and paper mills for a major construction and engineering firm, located in New York City. Experience in construction of same necessary. 40–60 age limit. Pay up to $20,000. Send résumé to R. D. Fordyce, Ward Howell Associates, Inc., 122 East 42nd Street, New York 17.

P501-55. Chemists or Chemical Engineers wanted for positions in the central research laboratory of a large specialty paper manufacturer in New Jersey. At least three years' experience in the paper industry required. Excellent opportunities for the right men with ambition. Interest in food packaging or industrial specialities desirable but not essential. Write giving full details and qualifications.

P503-55. Chemist. Excellent opportunity for young chemist interested in fiber products development. Work on semichemical pulping of northern hardwoods, and application of this pulp in a wide variety of fibrous products. Experience or interest in plastics or latex additives desirable. Assignment in Research and Development Center located in Lancaster, Pa. Reply sending details of age, education, experience, salary needs, etc. to: Personnel Administration Department, Armstrong Cork Co., Lancaster, Pa.

WANTED: RESEARCH CHEMIST

Immediate opening in research and development department of specialty paper manufacturer. Excellent opportunity for young man with initiative and imagination. Experience or background in paper technology, electrical insulation, and resins desirable but not essential. In first letter give complete résumé of experience, education, and present salary. Address Personnel Director, Hollingsworth & Vose Co., East Walpole, Mass.

P504-55. Production Trainee. Young college graduate 30 years of age or younger with training in wood technology or pulp and paper chemistry needed for production assignment in Pensacola, Fla., plant which manufactures a variety of fiberboard products. Six months' training program given with production assignment immediately following. Reply sending details of age, education, experience, salary needs, etc., to: Personnel Administration Department, Armstrong Cork Co., Lancaster, Pa.

P505-55. Chemist or chemical engineer with experience in pulp and paper mill or pulp paper laboratory. Opening for a project chemist in Northwest integrated mill.

P506-55. Major Consulting Engineer firm specializing in construction of Pulp and Paper Mills requires Engineers with Pulp and Paper Mill experience, to work on several large long-term projects. Categories include Structural, Design, Process Piping, Electrical system design, Plant Design and lay-out, Material handling, and Conveyor Design and lay-out. Offices located in Vancouver, British Columbia. In reply please state experience, and salary expected.

P507-55. Chemist or Chemical Engineer with boxboard experience. Mid-West mill has excellent opportunity for technical man who wishes to work close to production in the development and control of boxboard, medium and linear. Please submit full details regarding personal data, education, experience and salary desired in first reply to: Director of Board Research & Development, Central Fibre Products Co., Quincy, Ill.

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P509-55. Sales-Service Man Wanted. Established chemical company wants man with good paper mill or boxboard background for technical sales to board mills and corrugated board plants in central south. Good opportunity to expand established territory. Preferred age 25–35. Write TAPPI, P509-55, 155 East 44th St., New York 17, N. Y.

Note: Responses to advertisements appearing in the Employment Service should be addressed to TAPPI, 156 East 44th St., New York 17, N. Y.

Flexural Resistance and Deflection of Insulating Fiberboard*

TAPPI Suggested Method T 1003 sm-55

(THIS SUGGESTED METHOD IS UNDER THE JURISDICTION OF THE STRUCTURAL FIBROUS MATERIALS COMMITTEE)

This test method is for use in determining flexure strength and amount of deflection at loads, up to and including maximum load at failure, of rigid insulation boards composed of wood (or other vegetable) fibers of the type generally used for sheathing, insulating, and interior decoractive purposes. It is not recommended for evaluation of insulation boards for engineering use nor for boards greater than $^3/_4$ inch thick, except under conditions described under Additional Information.

APPARATUS

1. *Testing Machine.* This may be such as specified in TAPPI Standard T 404 m or any machine capable of being equipped with appropriate specimen holders and of measuring loads at the speed of test required to an accuracy of ±2%. The machine shall be equipped with a recording device capable of giving a graphic record of the applied load and the mid-span deflection of the specimen, or an indicating device for obtaining these values.

2. *Loading Head and Supports.* These shall consist of appropriate stirrups and stressing attachment when tensile forces from a tensile machine are used to load the specimen, or supports and loading head for compression loading equipment. The specimen shall be tested under center-point loading over a 12-inch span. The loading head and supports shall be cylindrical, of $^3/_4$-inch diameter and parallel to each other.

3. *Scale.* The testing machine shall be sufficiently sensitive at all loads so that the load on the specimen can be measured to the nearest 0.2 pound. The scale for measuring the amount of deflection shall give values to an accuracy of 0.05 inch or better.

TEST SPECIMEN

Specimens shall be cut from a representative sample accurately and parallel 3 ± $^1/_{32}$ inches wide, and with clean-cut edges, in each principal direction of the board. The over-all length of the specimen shall be 2 inches greater than the test span. All test specimens shall be conditioned according to TAPPI Standard T 402 m.

PROCEDURE

Whenever possible, the test specimens should not be removed from the conditioned atmosphere for test. When necessary to test at other than the conditioned atmosphere care shall be exercised that the moisture content of the specimen does not change during the test.

Arrange the stirrups and stressing attachment or loading head and supports so that the support cylinders are in a plane perpendicular to the movement and parallel to each other. Apply stress midway between the two bearing surfaces and at a rate so that the duration of the test will be 60 ± 15 seconds. For most products a deflection rate from $^1/_2$ to 1 inch per minute between the load and supports will satisfy this condition.

Tests shall be made on not less than three specimens cut from each of the two principal directions of the board.

Note: Since some boards differ in the density of their upper and lower surfaces, it is necessary to be consistent in the position of the specimens when tested. Where such differences do exist, the specimens should be tested in both positions and the lower values recorded. In controversial cases the position of the specimen with regard to its upper and lower faces shall be specified.

REPORT

The transverse strength in each board direction shall be reported as the average of ultimate loads for each direction, measured to the nearest 0.2 pound; the deflection of each direction shall be reported as the average of deflections for each direction, measured to the nearest 0.05 inch.

The modulus of rupture may be calculated from the maximum load by the following formula:

$$R = \frac{1.5PL}{w(t)^2}$$

where

R = modulus of rupture, pounds per square inch
P = maximum load at failure, pounds
L = length of span, inches
w = width of specimen, inches
t = thickness, inches

* This method is suggested by the Standards Committee as being the most suitable to date. It is *not*, however, a TAPPI Standard. Criticisms are earnestly requested and should be sent to R. G. Macdonald, Secretary, Technical Association of the Pulp and Paper Industry, 155 East 44th St., New York 17, N. Y.

ADDITIONAL INFORMATION

The method described is primarily for evaluation and comparison of rigid insulating boards; refinements may make it applicable for engineering use: (a) The use of a span 24 times the thickness of the board, and (b) having the diameter of the loading head and supports 3 times the thickness of the board.

REFERENCE

Lewis, Wayne C., "Effects of Speed of Test on Bending Strength of Insulation Fiberboard," *Tappi* 38, No. 2: 65–68 (Feb., 1955).

Flexural Resistance and Deflection of Fiberboard for Bookbinding*

Revision of TAPPI Suggested Method T 469 sm-45.

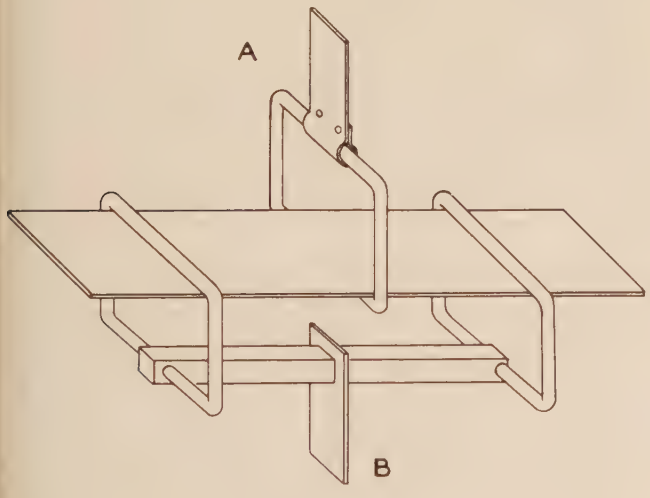
(THIS SUGGESTED METHOD IS UNDER THE JURISDICTION OF THE PAPER TESTING COMMITTEE)

This method is for determining the flexural resistance and the deflection of fiberboards used for bookbinding purposes. The method is suitable for measuring the stiffness of a sheet of such fiberboard and to give an indication of the serviceability to be expected of the board. It is not intended for structural board.

APPARATUS

1. *Tensile Tester* as specified in TAPPI Standard T 404 m, preferably equipped with a recording device which gives a graphic record of the applied load and deflection (*see* note below).

2. *Flexural Loading Device.* This device, shown in Fig. 1, is in two parts. The stirrup, A, is provided with



a tab for clamping in the upper clamp of the tensile tester. The bearing surface at the bottom of the stirrup is a smooth metal cylinder. The stressing attachment, B, carries an inverted stirrup at each end, similar to stirrup A, such that the cylinders are parallel with each other, and a tab in the center to be clamped in the lower (stressing) clamp of the tensile tester.

The span (distance between centers of the two cylinders in attachment B) shall be 3 inches and the diameter of the cylinders shall be $^1/_8$ inch.

Note: Any equivalent means of applying a measurable load to the center of a supported strip of the specimen and measuring the deflection may be used.

3. *Scale.* If the tensile tester or other apparatus used is not equipped with a device for recording the deflection, it may be measured with a scale graduated in 0.01 inch.

TEST SPECIMEN

The test specimens shall be cut from the sample in such a way as to be thoroughly representative of it. The test specimens shall be 5 inches long and 1 inch wide, cut accurately and parallel to within $^1/_{32}$ inch, and with clean-cut edges, in each principal direction of the board.

The specimens shall be conditioned for testing according to TAPPI Standard T 402 m.

PROCEDURE

The tests shall be made in an atmosphere conditioned according to TAPPI Standard T 402 m.

Fasten attachment B in the lower (stressing) clamp of the tensile tester with the axes of the two cylinders in a plane perpendicular to the direction of movement of the clamp. Fasten stirrup A in the upper clamp with its cylinder parallel to the other two and so that it will load the specimen at midspan. Counterweight the stirrup A, or determine the scale correction necessary to compensate for its weight. Run up the lower clamp with the attachment B until the specimen can be inserted, without bending it, under the two end cylinders and over the one at midspan, leaving equal lengths projecting at the two ends. Apply the load according to TAPPI Standard T 404 m until the specimen breaks or until after a maximum load has been reached. The rate of loading shall be such that the maximum is reached in not less than 30 nor more than 45 seconds.

If the testing instrument does not have a recording device for the amount of deflection at maximum load, measure it with the scale. Allow one end of the scale to rest on the lower clamp and read the scale opposite a reference line on the upper clamp at the instant loading is begun, at chosen intervals of loading, and at the instant of failure or maximum load.

* This revised method is suggested by the Standards Committee as being the most suitable to date. It is *not*, however, a TAPPI Standard. Criticisms are earnestly requested and should be sent to R. G. Macdonald, Secretary, Technical Association of the Pulp and Paper Industry, 155 E. 44th Street, New York 17, N. Y.

Tests shall be made on not less than five specimens cut from each of the two principal directions of the board.

REPORT

Report the results to two significant figures as the average flexural resistance (load at failure, or maximum load in case there is no failure) in pounds, and the deflection in inches in both principal directions of the sample for the dimensions of the specimen tested.

The report may also give the load corresponding to various increments of deflection or the deflection at various load increments.

ADDITIONAL INFORMATION

1. The modulus of transverse strength and modulus of rupture in pounds per square inch (p.s.i.) may be calculated by the following formulas:

$$\text{Modulus of transverse strength, p.s.i.} = \frac{3Pl}{2bd^2}$$

$$\text{Modulus of rupture, p.s.i.} = \frac{3\,Wl}{2\,bd^2}$$

where

P = load at elastic limit, pounds
W = load at rupture, pounds
d = thickness adjacent to rupture, inch
b = width of test specimen, inches

and

l = length of span, inches

2. This method previously covered all types of fiberboard. The present revision restricts it to boards used for bookbinding.

REFERENCES

Scribner, B. W., and Snyder, L. W., "A Study of the Physical Properties of Binders Board," *Paper Trade J.* 95, No. 16. 29 (Oct. 20, 1932).

National Bureau of Standards Commercial Standard CS50-34, "Binders Board for Bookbinding and Other Purposes."

Oxidation Resistance of Paraffin Wax (Peroxide Method)*

TAPPI Suggested Method T 650 sm-55

(THIS SUGGESTED METHOD IS UNDER THE JURISDICTION OF THE WAX TESTING COMMITTEE)

This method describes a procedure for determining the resistance to oxidation of paraffin wax by measuring peroxide formation during accelerated oxidation conditions. The original peroxide content of the paraffin wax sample may also be determined by omitting the oxidation procedure. The induction period, defined as the number of minutes required to obtain a peroxide number of 50 milliequivalents per 1000 grams of wax, may be employed as an indication of the tendency of the wax to develop malodors when stored at temperatures above its melting point.

The wax sample is maintained at a constant temperature of 275°F. while air, saturated with water vapor at room temperature, is bubbled through it. Aliquots are withdrawn at appropriate time intervals and the peroxide content is determined. A plot of time versus peroxide milliequivalents per 1000 grams of wax is constructed and, from the smoothed curve, the time in minutes required to reach a peroxide concentration of 50 milliequivalents is obtained.

APPARATUS

1. *Test Tube.* Pyrex glass, 2 inches inside diameter and approximately 12 inches long.

2. *Glass Gas-Dispersion Tube.* Pyrex glass, $14^1/_2$ inches long and constructed with positioning supports as shown in Fig. 1. (This is available from Corning Glass Co., Corning, N. Y., Cat. No. 39532.)

3. *Stainless Steel Cover.* 3 inches in diameter and constructed as shown in Fig. 1.

4. *Glass Sampling Pipet.* 6-mm. tubing, approximately 14 inches long.

5. *Constant-Temperature Bath.* Thermostatically controlled, and capable of maintaining the wax sample at 275 ±1°F. It shall be fitted with a stirring device to provide a uniform temperature throughout the bath and be of sufficient size to hold the desired number of sample tubes immersed in the liquid to a depth of approximately 8 inches.

The bath should be shielded in order to protect the wax sample from direct sunlight. If oil is used as the heating medium, it should be of a type which contains no additives and precautions should be taken to prevent contact of vapors from the bath with the test sample.

6. *Compressed-Air Supply.* With pressure regulator to provide a constant flow of air through the test sample.

7. *Air-Conditioning Train.* Comprising a system of scrubbers which will supply air free from oil, dirt or other contaminants, and saturated with water vapor at room temperature.

8. *Flow Meter.* With a capacity of at least 600 ml. per minute at 75°F. and an accuracy of ±100 ml. per minute.

The actual indicated quantity of air should be bubbled through the wax during the test period. Thus, in calibrating the flow meter due allowance should be made for any pressure drop through the apparatus.

9. *Thermometer.* For use in the constant-temperature bath. ASTM Precision Thermometer No. 67F-53, having a range of 210 to 310°F. and a maximum scale error of 0.5°F. at any point when standardized, is recommended.

10. *Iodine Flasks.* Pyrex glass, 250-ml. capacity glass stoppered.

REAGENTS

A. *Thiosulphate Stock Solution,* 0.1 *N.* Dissolve 12.5 grams of sodium thiosulphate ($Na_2S_2O_3.5H_2O$)

* This method is suggested by the Standards Committee as being the most suitable to date. It is *not,* however, a TAPPI Standard. Criticisms are earnestly requested and should be sent to R. G. Macdonald, Secretary, Technical Association of the Pulp and Paper Industry, 155 E. 44th Street, New York 17, N. Y.

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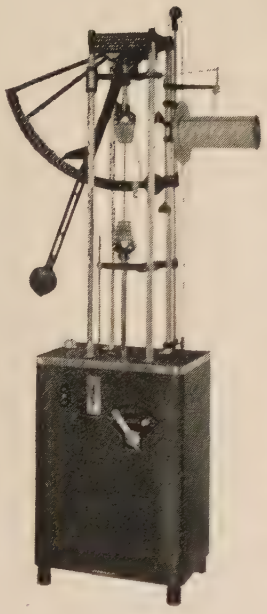

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and 0.1 gram of sodium carbonate (Na_2CO_3) in 500 ml. of water. (The Na_2CO_3 is added to stabilize the solution.) Let stand a week or more before using. Standardize against 0.1 *N* potassium bichromate ($K_2Cr_2O_7$).

B. *Thiosulphate Titrating Solution*, 0.005 *N*. Dilute 100 ml. of thiosulphate stock solution with water to 2000 ml.

C. *Potassium Bichromate Solution, 0.1 N*. Recrystallize $K_2Cr_2O_7$ twice from an aqueous solution of C.P. $K_2Cr_2O_7$ and dry at about 325°F. to constant weight. Dissolve exactly 2.452 grams of the purified $K_2Cr_2O_7$ in water and dilute to 500 ml.

D. *Potassium Bichromate Solution*, 0.01 *N*. Dilute 100 ml. of 0.1 *N* $K_2Cr_2O_7$ solution with water to 1000 ml.

E. *Potassium Iodide Solution*. Dissolve 120 grams of KI in 100 ml. of water. Discharge any color from this solution as follows: Put 1 ml. of KI solution, 50 ml. of water and 5 ml. of starch solution in a 300-ml. flask, and blanket with nitrogen or CO_2. If a blue color develops, add 0.005 *N* $Na_2S_2O_3$ from a microburet to discharge the color. Calculate and add sufficient $Na_2S_2O_3$ to the main KI solution to convert all free iodine to iodide. When properly prepared, 1 ml. of KI solution should not turn blue when starch solution is added, but with starch plus one drop of 0.01 *N* $K_2Cr_2O_7$ plus 2 drops of conc. HCl, the blue color should develop. Store this solution under chloroform by adding a few drops to the surface of the liquid.

F. *Starch Solution*. Dissolve 1 gram of soluble starch plus a few milligrams of mercuric iodide in 100 ml. of boiling water.

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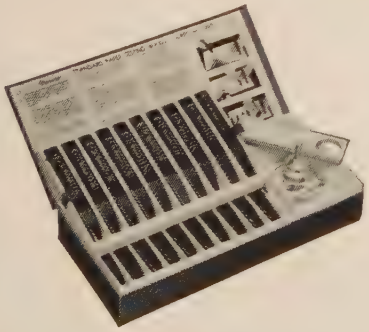

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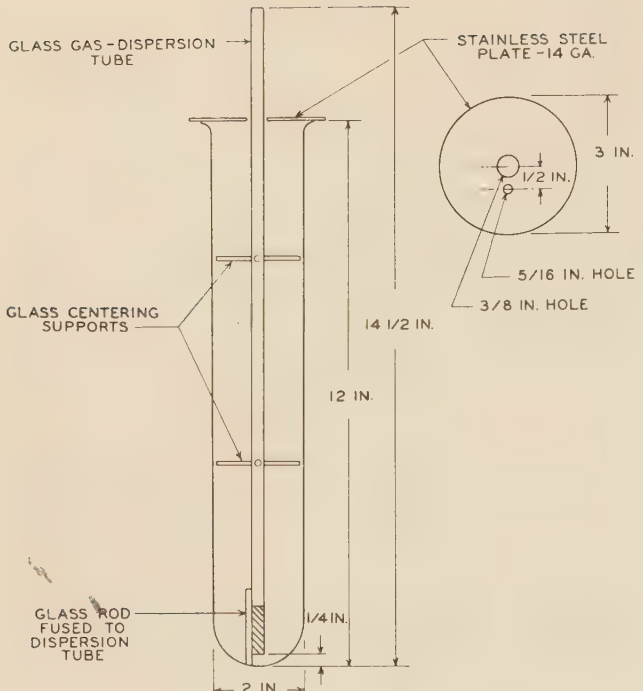


Fig. 1. Oxidation-resistance apparatus

G. *Acetic Acid Solution.* Glacial acetic acid containing 4 ml. of conc. HCl per liter.

H. *Carbon Tetrachloride* (CCl_4), technical grade.

I. *Distilled Water.* Wherever the use of water is specified, distilled water is meant.

PROCEDURE

Clean previously used test tubes by rinsing and scrubbing in hot naphtha with a long-handled brush; then repeat, using acetone in place of the hot naphtha. Prior to use, soak the test tubes at least 12 hours in chromic acid cleaning solution, rinse with distilled water, and dry in an oven at 212°F. or higher.

Clean previously used gas-dispersion tubes by boiling in successive portions of hot naphtha and rinsing several times with acetone. This operation should be performed under a hood or in a well ventilated location, taking care to prevent naphtha vapors from accumulating or coming in contact with an open flame. Prior to use, clean the gas-dispersion tubes with chromic acid solution, rinse with water and dry in an oven at 212°F. or higher. After cleaning, handle only with forceps.

Note: The most important consideration in applying the test is to insure cleanliness of the glassware. All apparatus which comes in contact with the wax sample must be scrupulously clean, particularly the gas-dispersion tube.

Weigh 75 grams (to ±0.1 gram) of approximately $^1/_{16}$-inch thick shavings from a representative sample of the wax into the oxidation tube. Assemble the apparatus as shown in Fig. 1, except that the gas-dispersion assembly is suspended by a clamp[1] above the level of the sample when molten.

Sweep the unit for 5 minutes with nitrogen or CO_2 to displace the air in the tube. Without turning off the purge gas, place the test tube in the constant temperature bath at 275 ± 1°F. and allow it to remain for 15 minutes ±10 seconds. Lower the air-dispersion assembly after the 15-minute period so that the lower end of the tube is $^1/_4$ inch from the bottom of the test tube (as shown in Fig. 1). Turn off the purge gas and immediately turn air into the sample at a rate of 600 ml. per minute. Record zero time as the time at which the air valve is opened.

At appropriate intervals, pipet 1-ml. aliquots for subsequent analyses from the test tube into weighed nitrogen- or CO_2-filled 250-ml. iodine flasks. Reweigh each flask and determine the weight of the sample to the nearest milligram. Do not withdraw more than six aliquots to establish the time-peroxide milliequivalent curve.

Aliquots should be spaced so that values close to 10, 20, 30, 40, 50, and 60 peroxide milliequivalents are obtained. The development of an oxidized odor in the wax sample may be used as an indication of the proper time to start sampling. Most paraffin waxes develop a definite odor at peroxide levels of 10 milliequivalents.

To each aliquot add 25 ml. of CCl_4 and warm gently on the steam bath to dissolve the wax. Do not heat above 150°F., as excessive heating destroys the peroxides. Pass a vigorous flow of nitrogen or CO_2 through the solvent for 1 minute; then, without stopping the gas flow, add 20 ml. of acetic acid solution which has been warmed sufficiently to prevent precipitation of the wax. Remove the flask from the steam bath and reduce the flow of gas so that the rate is 1 bubble per second. Add 2 ml. of KI solution and swirl vigorously for exactly 30 seconds. Set the flask aside to stand for 5 minutes ±3 seconds.

At the end of the reaction period, add 100 ml. of water and stop the gas flow. Titrate with standard 0.005 *N* thiosulphate to a light yellow color. Add 5 ml. of starch solution and continue the titration until the blue color disappears and does not reappear for 30 seconds or longer.

Titrate reagent blanks immediately before and after each set of unknown determinations as directed above, except that the sample is omitted.

Calculate the Peroxide Value as milliequivalents per 1000 grams of sample by the equation:

$$\text{Peroxide Value} = \frac{1000MN}{S}$$

where

M = ml. of thiosulphate for sample, minus correction for blank,
N = normality of thiosulphate, and
S = weight of sample aliquot, grams.

Plot milliequivalents (ordinate) versus time (abscissa) and draw a smooth curve through the experimental points.

REPORT

Read from the curve and report as the Peroxide Induction Period the time in minutes required for the sample to reach a peroxide value of 50.

PRECISION

The repeatability has not been thoroughly established but it is thought to be within ±5% of the mean of duplicate determinations.

The reproducibility has not been established.

[1] Spring-loaded spherical-joint clamp, Arthur H. Thomas Co., Philadelphia, Pa., No. 12 size, has been found convenient.

CHLORINE DIOXIDE BLEACHING

Record of the Pulp Purification Session—40th Annual Meeting

TUESDAY MORNING, FEBRUARY 22, 1955

The Pulp Purification Session of the Fortieth Annual Meeting of the Technical Association of the Pulp and Paper Industry, held in Parlors B and C of the Hotel Commodore, New York, N. Y., convened at 9:15 a.m., W. H. Rapson University of Toronto, Toronto, Ont., presiding.

Chairman Rapson: Gentlemen, we are very glad to welcome you all to these sessions of the Pulp Purification Committee today.

Our first paper this morning is on "Chlorine Dioxide and Safety," by J. F. Haller and W. W. Northgraves, of Olin Mathieson Chemical Corp. The paper will be presented by Walter Northgraves (see *Tappi* 38, No. 4: (April 1955)).

(Mr. Northgraves read a prepared paper.)

Chairman Rapson: Thank you very much, Walter. I think it is a very good thing that our fears have now been allayed as to how dangerous chlorine dioxide is to handle, and I appreciate very much your presenting this paper to us this morning.

In practical terms how can we interpret these parts per million figures? Years ago, I set a very simple rule for the mills. If you can smell chlorine dioxide, it is dangerous, and the atmosphere should be changed, or you should get out of the atmosphere. Some of you may think that is too stringent a rule, but I think you will find it is a very good one.

Actually, there is no need for a mill using chlorine dioxide to smell of chlorine dioxide. You can walk into many mills today using it without detecting the odor at all, and you won't know what chemical is being used from the odor of the plant.

Are there any questions on this paper?

Robert Wheless (Camp Manufacturing Co.): Have you had any experience that an extraordinary number of people are supersensitive to chlorine dioxide?

Mr. Northgraves: No. As far as I know, we have not. Now, of course, that doesn't mean that such people might not exist, but not in our experience.

H. B. Channon (Virginia Smelting Co.): Do you have any simple test to determine the presence of chlorine dioxide in air?

Mr. Northgraves: No, we do not. Our feeling is that if you can't smell it, there is just no chance in the world it can do you any harm. If you can smell it, well, that's a warning to get out of the area and take whatever measures are necessary to correct the leaks or whatever the source of the trouble is. However, I want to emphasize very strongly that if you can't smell it, there simply is nothing at all to worry about.

Chairman Rapson: If you have smelled chlorine dioxide on a particular day, you are no longer a good subject for testing chlorine dioxide. I personally have had the experience that if I smell chlorine dioxide and get a good shot of it in any one day, I can smell it all day long wherever I go; so you have to have a fresh subject every time you want to test the atmosphere!

John Schuber (Solvay Process Div.): You mentioned a little while ago that there are very many mills in the North American Continent that you can walk through without even smelling chlorine dioxide. I thoroughly agree with you, but I would like to ask this question. Those mills that you have reference to, do they have the totally enclosed cell or do they have the open type? I am wondering if that is true of the cells that are open to the atmosphere.

Chairman Rapson: I don't know any mill that does not enclose the equipment using chlorine dioxide for bleaching, and provide adequate ventilation for it. This is an essential as far as I am concerned. I don't know any mills that have open bleaching vessels from which the chlorine dioxide can escape into the air. Perhaps someone else may know of such mills. I don't.

Any other questions? (There were none.) If not, then, let us go on to our second paper. Thank you very much, Walter, for this very fine presentation. We appreciate it very much.

Our second paper will serve as the introduction to our panel discussion to follow it. It is called "The Effect of Variables on Chlorine Dioxide Bleaching of Sulphate Pulp," by W. D. Harrison and C. R. Calkins of Riegel Paper Corp. Dick Calkins will present the paper (see *Tappi* 38, No. 11: 641–648 (1955)).

(C. R. Calkins read a prepared paper.)

Chairman Rapson: Never was so much said in such a short time. A great deal of hard work was presented in those curves.

We have, because of the shortness of the presentation, a reasonable time for discussion of this paper.

Mr. Sproull (Herty Foundation): Do you have any chemical analysis of those pulps that had a brightness of around 85?

Mr. Calkins: No, we do not.

D. B. Kuhe (Crossett Paper Mills): Can you give any information on the reversion of brightness with these pulps?

Mr. Calkins: Well, they revert. They tend to drop off very quickly in the first 12 to 24 hr. In some cases there is actually a drop of several points.

We decided to report our data at 24 hr., because at that time the curves were leveling off pretty well. On all our samples we took our brightnesses pretty regularly, got our curves, and picked off our brightnesses at 24 hr., which we found smoothed up our curves.

Chairman Rapson: I hope you will keep all those samples and re-measure them a year from now.

Norman Lee (Scott Paper Co.): Did you run any tests to show the effect of chlorine dioxide on dirt removal?

Mr. Calkins: No, sir, we did not. We went entirely by brightness.

Chairman Rapson: It is almost impossible to do dirt studies on small handsheets in my experience.

Don Baker (Harmac): You mentioned 0.55% chlorine dioxide on pulp as the maximum concentration to use. Did you find that over 0.55 there was no material increase in brightness even though the time was lengthened?

Mr. Calkins: We ran one curve. We did not lengthen the time, but we increased the chlorine dioxide. We did not change both variables. When we added more chlorine dioxide at 2 hr., the increase was relatively small, as you saw in that one curve; but we did not run both increased time and increased chlorine dioxide.

Mr. Baker: I didn't phrase that question quite right.

What I was trying to ask was, did that seem to be the maximum chlorine dioxide that you could usefully absorb in the pulp?

MR. CALKINS: I would say so, yes. The increases after that amount did not appear to be very large. There was a slight increase, but we felt that when we added that amount it was enough.

MR. BAKER: In other words, you had a sort of brightness ceiling that you couldn't break through, even though you increased the chlorine dioxide?

MR. CALKINS: Under these conditions we are approaching such a ceiling. That doesn't mean that there aren't other ways of doing it, other techniques, possibly two-staging, by which you could not go higher; but, the way we did it, that is correct.

GEORGE CLARK (Coosa River): Is there any occasion that when you raise temperatures, say, from 155 up to the high temperatures—say, 200, 215—that there might have been less reversion?

MR. CALKINS: I am sorry to say that we did not specifically inspect our data from that point of view. I think we should go back and look at that, perhaps, but I can't answer that question as of now.

MR. CLARK: Perhaps you could answer that question, Mr. Rapson?

CHAIRMAN RAPSON: I'm sorry, I can't either. This is one field in which there is insufficient information as to the effect of variables on reversion. For the first time this morning we have had precise data on the effect of variables on brightness, which is something. We will have to wait a year before we get information on the effect of variables on reversion.

GEORGE TOMLINSON (Howard Smith): In running the tests with the pressure bleacher, did you have the stock hot before you added the chlorine dioxide as it would be done in the mill?

MR. CALKINS: Yes. Actually, the stock was preheated and everything was added in our bleacher. I didn't go into detail about the pressure bleacher. It was quite a construction job. It was set up to get the stock in and to add the chlorine dioxide afterwards. We preheated our polyethylene bags, too.

F. L. FENNELL (Peroxide Products Development, E. I. du Pont de Nemours & Co.): How many stages of treatment preceded the chlorine dioxide treatment?

MR. CALKINS: This is a five-stage southern kraft.

CHAIRMAN RAPSON: What were the stages? That doesn't answer the question.

MR. CALKINS: I have this only by information. I am not really close to our pulp mill, but it is chlorine, caustic, hypo, caustic, hypo, I understand. I can be corrected by a number of people here.

CHAIRMAN RAPSON: That is correct. I see a number of nods in the audience.

WARD HARRISON (Riegel Paper Corp): The answer is almost correct. The last three samples, Dick, were bleached to get the effect between 66 and 77. All of the samples were the same, except for those last three, and as you can see, even though it was bleached further, it didn't make any difference in the final result. Chlorine dioxide is a great leveler.

There is one other thing I might say while I am up. In the mill we seem to be more sensitive to temperature than we were in the laboratory. We showed that we could go on up above 165°F., and still not hurt the pulp too much, but in the mill it is pretty sensitive at that point.

MR. CLANNON: Have you made any studies on stabilization factors after bleaching in regard to reversion?

MR. CALKINS: To prevent reversion? Is that your question, sir?

MR. CLANNON: Yes.

MR. CALKINS: No, sir, we have not.

MR. KUHE: I notice that the brightness increases from 60 up to 80. Did you use five stages to get up to 60 or 65, or were all five stages used in reaching the varied levels from 65 to 80 in the prebleach?

MR. HARRISON: We had two grade stocks. One was 70 brightness and the other was 66. Is that right?

MR. CALKINS: Yes.

MR. HARRISON: The 70 brightness was controlled in all of the experiments except the very last figure, where we took a little wider range than we could get with the 70 brightness, and we wanted to start with various brightnesses, so we took the 70 as one, and used our standard conditions on that. We took the 66 brightness stock and applied the standard conditions to it.

Then we took each of these, 66 and 70 brightness pulp, and gave one more hypochlorite bleach, the 66, to bring it up to 68, and the 70, to bring it up to 74, I think.

MR. CALKINS: It was 77, I think.

MR. HARRISON: And we took all four of those and tried to find out what would happen, and we found out, as you saw in the last figure, that we got about the same brightness with 0.55 of a per cent chlorine dioxide with the same consistency, with the same everything else—all the other variables—with one pulp as we did with the other. In other words, chlorine dioxide is a great leveler.

MR. SPROULL: Have you tried as a last step peroxide bleaching? That is, sodium peroxide after the chlorine dioxide?

MR. CALKINS: No, sir, We have not.

CHAIRMAN RAPSON: I must point out that the panel is going to meet very soon, and these same questions can be addressed to any member of the panel; so I would like to ask that the questions here be strictly on this paper.

MR. STOREN (Niagara Alkali Co.): In your slides showing a drop off of brightness with increased pH, with additions of sodium hydroxide, did you take your residual chlorines to the same point?

MR. CALKINS: We didn't study that effect. We didn't check our residuals at the end, so I couldn't really answer that.

MR. WILKINSON (Champion Paper & Fibre Co.): Mr. Harrison inferred that his standard five-stage bleaching system was not used to get the 66 brightness pulp. I would like to ask what sequence he did use to get that.

MR. HARRISON: You misunderstood. It was used, the five stages. We make a semibleach pulp. We are using five stages, and we just took a bale of that as a standard, both for the 70 and the 66.

CHAIRMAN RAPSON: They don't put in as much chemicals to get the brightness, but the stock passes through all the stages.

MR. HARRISON: That's right, and when you use chlorine dioxide you are wasting it if you put too much in.

MR. TOMLINSON: Does that hold in the mill, so that you can go in with lower brightness or higher brightness and still come out with the same brightness?

MR. HARRISON: I would rather not answer that question, because anything can happen in the mill, and these are controlled test conditions.

CHAIRMAN RAPSON: These questions may be addressed to the panel.

MERRILL HEATH (Buckeye Cotton Oil Co.): After the chlorine dioxide bleach, did you simply wash out the chlorine dioxide?

MR. HARRISON: That's right. We actually took our brightness sample immediately from the bag and washed it immediately with distilled water very thoroughly, and then we washed the rest of our stock with mill water and went on from there, and no souring or additives or anything was done. It was just distilled water washing.

I think I answered Mr. Wilkinson's question too fast. Last year we presented data, and we have the slides here today. It was all mill data, because that's the only way we knew how to get that last year, and those data were never

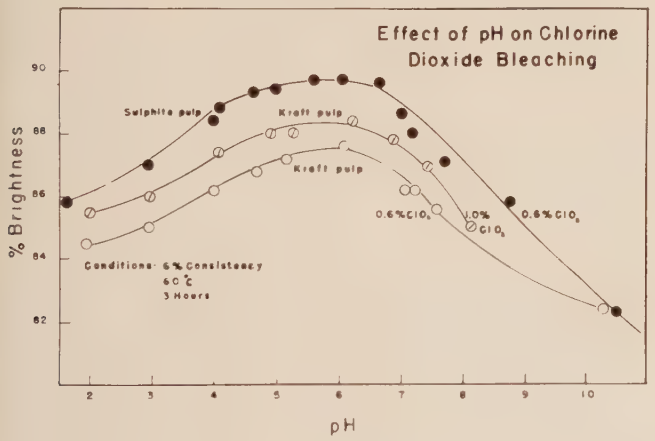
published because we were afraid of them, and we told you at the time we were afraid of them, because it is so difficult in in the mill to hold everything constant. Every time you start a set of tests, you have a new base, and we had to show that on the slides.

This year we resolved to do this in a precise way, just as precisely as we possibly could, and we spent a good part of the year working on that pressure bleacher, because we thought it was so important to do it that way, and we had a lot of heartaches. We built it one way, and it wouldn't work, and we built it another way, and it wouldn't work, and we used up most of the whole year working on the equipment. About 3 months ago we started working in two different directions, and pretty late this year we still didn't have everything we wanted. As a matter of fact, we threw out a lot of work very late in the year, and went to distilled water and a lot of things that we hadn't done before.

So, I don't want to appear short in my answer to you, but it has been rough to use the mill data—with all due respect to the mill. They are doing a wonderful job, but the one way to do it is in the laboratory, if you want to hold all these variables constant.

CHAIRMAN RAPSON: I am glad you pointed out, Ward, that these fine data you presented here are not the only ones that you have. I am aware of the difficulties of nailing down details in research of this precise nature. I listened very carefully, and I may say that everything stated here fits in with my experience very accurately. Everything was very carefully and precisely stated, especially the effect of, for instance, adding caustic soda. No claim was made that it was due to certain pH effects, but it was simply stated what the effect was of adding certain amounts of caustic soda.

I wonder if I might be forgiven if I were to show some recent data I have from our laboratory on the effect of pH on chlorine dioxide bleaching, because the effects that are shown there for adding caustic are due to pH effects.



These are experiments carried out with buffers where the pH was kept right at each pH level from the beginning to the end of the experiment, and this shows the effect of pH.

You will notice that we have here both sulphite and kraft pulp with 0.6% ClO_2, and that we went to 1.0% ClO_2 with the kraft pulp. We see that there is a peak where we get the maximum brightness, right around pH 5 or 6 and it falls off very rapidly after passing pH 7.

Therefore, in the experiments presented this morning, the addition of caustic would perhaps locally send the pH higher than 7, and with the effect of rapidly losing chlorine dioxide and losing brightness, as shown here.

I just wanted to mention this, because that was the only point I could see in the paper where there might be some need for further clarification.

MR. SCHUBER: I would like to say about this paper that it certainly is an excellent paper, and it applies particularly to one company. We have similar data that apply to many other companies. I just thought that Mr. Calkins and Mr. Harrison would like that little verification, that it isn't just one pulp. All of what has been said this morning is applicable to all grades of pulp.

CHAIRMAN RAPSON: Thank you very much, John. I think they will be very pleased to know that their data are more or less generally confirmed by the varied experience of other people.

Now, I want to thank both Dick Calkins and Ward Harrison, and all those others at Riegel who carried out this work and presented it this morning. It was a wonderful contribution to our symposium.

PANEL DISCUSSION

CHAIRMAN RAPSON: The Pulp Purification Committee is very proud of the panel we have arranged for the discussion this morning. We have among us on the panel and in the audience people who have had experience with chlorine dioxide for a long time. We have people who had experience in the early days in various companies who pioneered chlorine dioxide. I would like to introduce the panel and one or two other people in the audience.

Chlorine dioxide began to be used in Sweden and Canada about the same time, about 1946. We have two representatives of Mö och Domsjö AB, in Sweden, who were among the pioneers in that country. These gentlemen are a little too young to have been associated with the first development, but they are here representing their company today.

I had hoped that they would sit on the panel as full members, but they tell me that their personal experience with chlorine dioxide is somewhat limited. Nevertheless, I would like you to know that they are here. First, I would like to introduce Aksel Scholander, assistant technical manager, and Sixten Regestadt, director of research of Mö och Domsjö AB. We are very glad to have you with us today, gentlemen.

I was involved in the first chlorine dioxide use in mills on this continent. Then the next use was at Harmac mill of MacMillan & Bloedel, in British Columbia, and we have the pioneer of their chlorine dioxide work here, Don Baker, technical supervisor and assistant mill manager.

The next mill to use chlorine dioxide was the Riegel Carolina mill at Riegelwood, N. C., and representing them we have the vice-president and resident manager, Chick Hartford.

And then we have two relative newcomers to the field of chlorine dioxide bleaching. It is good to be modern, and so we have Bob Wheless of Camp Manufacturing, bleach plant superintendent and we have George W. Brumley, vice-president and resident manager of St. Mary's Kraft, one of the most recent mills to start using chlorine dioxide.

Now, I have asked each member of the panel to tell us very briefly what his particular mill is doing with chlorine dioxide bleaching, and it might be just as well to do it in chronological order, not of age, but of use of chlorine dioxide. So I will first ask Don Baker to tell us what MacMillan & Bloedel are doing with chloride dioxide.

MR. D. H. BAKER: The Harmac mill of MacMillan & Bloedel went into operation in 1950 on unbleached pulp, and in 1951 on bleached pulp.

When our company began to look into the possibilities of bleaching kraft pulp, we reviewed what had been done in the industry in Sweden, and there were three users of chlorine dioxide at that time. There was the Mö och Domsjö AB, at Husum, that being their kraft mill; Stora Koppersberg at Skutskar, who were just getting into the manufacture of chlorine dioxide but of which we had very little information on their operations; and then there was the mill at Korsnas, at Gaevle, where Mr. Rosen was more or less the developer of the process. But we did not know for certain whether they were using it. We knew that he had developed it, and had done some of the original work, but as to the actual mill

operation, we weren't just sure how that had been working out.

I visited Sweden in this connection, and as a result of our investigations we decided to go to the Mö och Domsjö system, as that system had been in very successful use, and they had been making a very high-quality, high-brightness pulp, so that is the system I will outline to you today. It is essentially what Mö och Domsjö had in those years, and to the best of our knowledge, still have.

Our mill is a Kamyr-designed bleach plant. By that I mean that all the towers are Kamyr towers, and most of the equipment is Kamyr. The equipment was modified to some extent to suit conditions in this country, but we have eight towers, eight washers, and it is essentially an eight-stage bleach; but we do have a final sulphur dioxide souring operation which you could call a ninth bleach. So, if you really count everything, it is a nine-stage operation.

We prepare our unbleached pulp to a rather high permanganate number, and the average is around a 22 or 23 permanganate number with, therefore, a high chlorine consumption.

We bleach in the first chlorination tower at $4^1/_2$ consistency —and these consistencies are all moisture free—about 65 to 70°F. Our retention time is 50 to 60 min., and the chlorine consumption is about 8% on the pulp. That's a rather high chlorine consumption, but it is due to the fact that we are using high permanganate numbers.

The reason for the high permanganate number gets back to strength. The West Coast woods have a certain fiber characteristic that gives us, in some respects, poor papermaking characteristics when compared to northern spruce and northern pine.

We operate primarily on the residual chlorine at the end of the chlorination stage. We run permanganates, of course, but not so much as a control, but more as a forecast to the bleach operators what to expect in the way of chlorine flow.

The residual we carry amounts to about 0.4 to 0.6% on the pulp, or a concentration in the pulp of about 0.15 gram per liter.

The next stage is caustic extraction. We carry this out at a temperature of about 135 to 140°F., consistency of 8% in the tower, and for approximately 2 hr. or 2 hr. and 20 min. We have a terminal pH of about 10 to 10.5.

This is a stage which we are looking into, because we are not certain about all the variables that tend to give the best operation. It is quite a user of steam, and it is a large user of caustic, and if we were able to reduce the usage of either of these items, it would certainly contribute to lower costs.

The third stage is hypochlorite. I did not mention, incidentally, that the chlorination is done in a standard, low-density Kamyr upflow tower. The caustic extraction is done in a standard high-density downflow tower. The first hypochlorite is done in a low-density Kamyr tower—except that it is really a medium density. The consistency is 5 to 6%.

We run a temperature of 70 to 80°F., and our residual, again, is on the order of 0.2 to 0.3% on the pulp, and we have a terminal pH of 9.5, and a terminal color of 50 to 60 G.E. So, we have come up quite a way in the semibleach color, and so far there has been very little loss in strength in the three stages. It is unmeasurable.

After the first chlorination, of course, we have washed; after the first caustic, we have washed.

The first hypochlorite is an unusual type of tower. I believe it had its origin in a German patent. At any rate, the pulp overflows the top of the tower, drops into a sump and is diluted with a large volume of acid white water from the first chlorination. That immediately converts the pH from around 9, very quickly to a pH of about 3 or a little under. The pulp is delivered to the next stage, second chlorination, where chlorine is added at the rate of about $^1/_{10}$ of 1%.

The pH in the tower is 2.5 to 3.5, and the temperature is about 70°. We are not certain what this contributes to the actual bleaching cycle, but it appears to have some good effect, because if we eliminate it, we notice that we come out with lower terminal brightness.

Then we wash after this stage. You can see when you think about this stage that any unconsumed hypochlorite doesn't go to waste, because it is also converted over to chlorine, and you release chlorine, theoretically, within the fiber, and that is supposed to be able to attack lignin which is in the inner lamella.

Then the next stage is the high density caustic tower. We sometimes operate that as straight caustic extraction, and sometimes operate it as a high-density hypochlorite bleach. Of course, when we operate it as the latter, we use a very small amount of chlorine, roughly a tenth of a per cent, at a temperature of about 100°F., and the terminal color is anything from 70 to 75 G.E.

The pulp is then washed, and the next stage is the first chlorine dioxide stage. I will have to use the terms we are familiar with, and we probably are a little different from most people in the industry. We talk about it in terms of available chlorine; in other words, its activity compared to elemental chlorine.

We operate this stage at 10 to 12% consistency, 135°F., and about 165 min. retention time. We use roughly 1.3% chlorine dioxide (available Cl_2) in this stage. We carry a residual in the final washer vat, and we go very largely on the usage of chlorine dioxide in this stage by the pulp color following washing. We usually maintain a slight trace of color in the vat, so that we feel certain that there is enough chlorine dioxide to prevent any reversion at the end of the bleaching operation.

This is the first part of the bleach plant where we are troubled with serious corrosion. Because of the high temperatures involved, it is difficult to get any material to stand up for any length of time. We went mostly to stainless steel, types 316 and 317, and in order to protect the washer vat and the piping and the stainless agitators, we add caustic soda to the white water system, and carry a pH in the base of the tower of about 8 to 9.

This has no effect on neutralizing any residual chlorine dioxide, but there is evidence that it does slow down the rate of attack on stainless. Nevertheless, our stainless washers and our stainless piping are being very badly attacked, mostly by pit corrosion.

The pH of the tower is inherent in the system as obtained from Mö Domsjö, but the evidence that we have had in the mill certainly bears out what you have heard from the Riegel Paper Corp. and Mr. Rapson's remarks, because our entering pH is somewhere around 5, and we believe our terminal pH is somewhere around 4, but we can't measure that too readily. It is very difficult to extract a sample from the middle or the bottom of the tower, and of course, we neutralize the stock in the bottom of the tower, so we have to arrive at this pH more or less by inference. However, based on trial periods without caustic, it is more or less in that range.

The stock is washed, and then we have an intermediate soaking tower. The consistency is about 4%, and the time is roughly 70 min., and the temperature is whatever is available in the white water circuits, which is generally about 125 to 130°F.

Although there is no residual chlorine dioxide maintained in this tower, the white water circuits carry enough residual to damage the rubber covering of the following washer, as the covering lasted only a year and a half. The pulp leaving the washer has now reached a level of 83 to 84 G.E.

The following stage of chlorine dioxide is run very similarly to the first stage, at a consistency of 10 to 11%, a temperature of about 160°F., and the same retention time of roughly 165 min., but we use a very small quantity of chlorine dioxide. It is less than 0.5%.

The pH conditions are roughly the same—slightly higher in pH, because there is less chlorine dioxide to reduce the pulp to a lower pH—it runs about 5.0 to 6.0.

Then alkaline water is again injected into the base of the tower to preserve the pipelines and washer, and the stock is washed, the last shower on the washer being a sulphur dioxide shower.

This has been a point we have debated for many years, but we still use sulphur dioxide because we believe it has a definite place in the system.

Then the stock goes into high-density storage, and the souring action of the sulphur dioxide carries on in the high-density storage for various periods, depending on the operating rate. There is definitely a trace of residual sulphur dioxide with a pH of 3 to 4.

The brightness that we are obtaining now is 88 to 90, mostly around 89, and is what we would call a fairly permanent brightness, because it is measured somewhat the same as they do at Riegel—about 24 hr. later— and we get about 0.5 points reversion over the first couple of weeks.

Reversion from then on is very difficult to measure accurately, and it is something that we have been investigating.

I asked a question of Mr. Calkins when he was giving his paper about the ceiling, because there does appear to be a ceiling, and we can't break through it. At the moment it appears to be about 90 G.E. and even though we prebleach strongly and use extra chlorine dioxide, we still can't get through around 90. It is now the subject of an investigation by our technical staff, and we are interested to hear anybody else's experiences along these lines.

Chairman Rapson: Thank you very much, Don. We certainly got a great deal of information in a short time there.

I am going to ask Aksel Scholander if the practice at Mö och Domsjö is still approximately what was described by Don Baker.

Aksel Scholander: Yes, as far as I know, the same as the figures Mr. Baker mentioned. We are operating the same system.

Chairman Rapson: Thank you very much. So, we had two systems described at once there.

Now, I am going to ask Chick Hartford to tell us what they do at Riegel with chlorine dioxide.

C. E. Hartford: We have been using chlorine dioxide for bleaching at Riegel-Carolina, for approximately $2^1/_2$ years. We bleach both the southern pine and gum in this bleach plant. It is a six-stage bleach plant with equipment by Improved Machinery Corp.

We are bleaching a 20 permanganate pulp, and in the chlorination stage we bleach at about $3^1/_2$% consistency, at 85°F., and on the pine pulp we use 4 to $4^1/_2$% chlorine.

In the first caustic extraction stage we maintain a pH of about 10.5 to 11. We use a temperature of 155°F. We have a retention time of 30 min. in that stage. The consistency is about 14%.

In the first hypochlorite stage we bleach at a pH of $9^1/_2$ to 10. We use 1 to $1^1/_2$% hypochlorite. We use 0.2 to 0.3% caustic as a buffer. We bleach at a temperature of 100°F. The retention time at this stage is about 2 hr., and the consistency again is 14%.

We bleach in this stage to a brightness of about 60.

In the second caustic extraction stage the conditions are very similar to those in the first, except that we are using less caustic, of course. We use about 0.1 to 0.15% caustic in that stage.

In the second hypo stage we have a retention time of about 2 hr. consistency about 14%, the pH is $9^1/_2$ to 10, the temperature is 100°F. We use 0.1 to 0.2% hypo, with about the same amount of caustic as buffer, and we bleach in this stage to about 72 brightness.

I can see from Dick Calkins' paper this morning that we have some thinking to do in the mill about the brightnesses that we bleach to in these hypochlorite stages.

We follow the second hypo stage with our chlorine dioxide stage. We have a consistency of about 10% in this stage. The retention time is 2 to $2^1/_2$ hr. We use 0.5 to 0.6% chlorine dioxide to bleach to a brightness of 85 to 87.

The pH after the chlorine dioxide addition is about 3. We use sulphur dioxide solution in the bottom of the tower to neutralize the residual chlorine dioxide, and we come out of that tower at a pH of 2 to $2^1/_2$. Then we adjust the pH of the pulp going to the machine to 5.5 to 6 with caustic.

I think that pretty well summarizes the process, and of course we will have questions which will probably throw light on other parts of the process.

Chairman Rapson: Thank you very much, Chick.

Now, I am not sure just what is the order of time here. I think perhaps Camp had the chlorine dioxide operating before St. Mary's, so I will next call on Bob Wheless to tell us what they are doing with chlorine dioxide at Camp Manufacturing.

Mr. Wheless: We were only shortly before St. Mary's, so don't know that we can be qualified as experts, by any means.

Let me give a word of explanation about our bleach plant. We have had it in operation since a year ago in October, when we started up the five-stage sodium hypochlorite bleach plant.

At the present time we are operating as a four-stage bleach plant. We had a second caustic stage; so we are using chlorination, caustic, hypo, and a blank, and then chlorine dioxide. We found the second caustic was not doing us too much good.

I am hoping to find some use for that stage. I'll work on that!

I think it is hardly necessary for me to go through our bleaching conditions, because they are almost identical to the ones you have just heard Mr. Hartford give you for their conditions and their various stages. We are only bleaching to a final brightness of 83 to 85 out of the chlorine dioxide stage. We differ from them in that we neutralize with caustic at the base of the tower. We go into the chlorine dioxide stage at a brightness of about 60, with one-stage hypo.

As far as the other conditions are concerned, they are very similar to the ones that he just stated. There is a reason for that, but I think that can probably wait until the questions.

Chairman Rapson: Thank you very much, Bob.

Now, we will ask George Brumely what they are doing at St. Mary's Kraft with chlorine dioxide bleaching.

G. W. Brumley: My presence on this panel does not indicate any exceptional knowledge of either conventional bleaching or the use of chlorine dioxide, but is rather occasioned by the fact that we have a relatively new bleach plant in which we are doing something that is not as conventional as some others.

We have a five-stage system, at least, we are operating it as a five-stage system at the present time. Most of the stages, as far as the conditions under which we are bleaching, correspond to the stages which you have heard outlined. By that I mean that our chlorination stage is similar to those of the conventional bleach plants. Our caustic extraction stages, as such, are conventional.

The unconventional part of our operation is that we are bleaching with chlorination, caustic extraction, and chlorine dioxide only. That is, we are not using any hypochlorite in the system as far as bleaching is concerned.

We handle the chlorine dioxide application in two stages. We have replaced the hypochlorite, so to speak, in the conventional five-stage bleaching system, in that we are using chlorine dioxide in the third and the fifth stages. We are producing with that system a pulp with an average controlled brightness of about 87 to $87^1/_2$ on the fifth stage. Upon a few occasions we have operated up into the 90 brightness range, but as a routine control matter, we have an 87 or $87^1/_2$ range.

As you can possibly gather from the comments of others

and the previous papers relative to the use of chlorine dioxide, we have found relatively little strength loss in our operation, with obviously a high brightness and an excellent dirt count, with very little reversion.

The brightnesses given to you are not only the brightnesses out of our fifth stage, but they are the brightnesses of the pulp in the finished bale. By that comment I mean to infer that in passing it across the conventional pulp-drying machine, there is practically no reversion.

As I pointed out previously, I will not go into the details of each individual stage, because the stages, as such, are operated to a great degree in the manner which was previously been covered, but the difference in the operation of our system is that chlorine dioxide is applied to the pulp immediately after the first caustic extraction—which is, of course, in a brightness range of 28 to 30.

Out of that first chlorine dioxide stage, we are in a brightness range of 60 to 65, and in the second chlorine dioxide stage we are in the brightness range of 87 to 88.

CHAIRMAN RAPSON: Thank you very much, George. You see, we have a wide variety of ways of using chlorine dioxide represented on the panel.

You also can see that we have a lot of experience with corrosion and with conditions of bleaching and effects obtained.

You will now have an opportunity that has never been had before in any meeting of which I have been aware, to address questions relating to chlorine dioxide bleaching to the members of a panel; but I would also like to invite audience participation—not just asking questions, but anyone may tell of their experience, or answer questions, or discuss matters as well as ask questions. The floor is now open.

FRED BISHOP (Southland Paper Mills): Mr. Brumley, I understood you to say that out of your first chloride dioxide tower you had 60 to 65 brightness. Is that right?

MR. BRUMLEY: Yes.

MR. BISHOP: What is your retention time in that first tower?

MR. BRUMLEY: I am afraid I should add a little something first, Fred. Our towers are large towers, with a designed capacity rate of 250 tons. We can get about 4 to $4^1/_2$ hr. retention time, if we want to use it.

MR. BISHOP: Do you have any residual out of the bottom of the tower?

MR. BRUMLEY: We do, yes. In other words, we regulate our retention time to give us a slight residual.

MR. BISHOP: Do you mean you run the level down in the tower in order to reduce the retention?

MR. BRUMLEY: That's right.

MR. BISHOP: Then you have a correspondingly short retention time? I mean, is it in the order of 2 hr., or is it 4 hr., or what?

MR. BRUMLEY: Our normal operation at the present time is nearer $3^1/_2$ hr. retention time in that tower, because we are adding in that tower about 0.75 to 0.80% chlorine dioxide.

MR. BISHOP: The reaction rate isn't as fast as I thought it was. Thank you.

MR. KUHE: Have you folks made any comparison of the cost using hypo followed by chlorine dioxide, as they are doing at the present time?

MR. BRUMLEY: We have operated this plant only on the basis as outlined to you. We are relatively a new plant with only about 4 months' operating experience, and consequently we are not in a position to give you comparative cost data on a cost operation using hypochlorite.

CHAIRMAN RAPSON: Does anyone else on the panel have a cost comparison of hypochlorite versus chlorine dioxide? Does anyone in the audience have such a cost comparison?

MR. SCHUBER: We have it. Of course, we haven't translated that, as Mr. Brumley has stated, into commercial practices. However, we feel with the two-stage chlorine dioxide, using the practices that Mr. Brumley has spoken of—that the cost is practically the same. There is no difference.

CHAIRMAN RAPSON: Any other comment on the cost of chlorine dioxide compared with hypochlorite? (There was none.)

I have already published some calculations which confirm the statement made by John Schuber, that the costs of sodium hypochlorite and chlorine dioxide are very little different. Calcium hypochlorite is slightly cheaper than chlorine dioxide, but not much.

MR. BISHOP: Is that all predicated on pure chemical cost?

CHAIRMAN RAPSON: What do you mean by "pure"?

MR. BISHOP: Just your chemicals in bleaching alone? You don't allow for any increase in yield?

CHAIRMAN RAPSON: My statement was based on chemical costs, including operating costs for producing the chemicals.

WILLIAM F. HUGHES (J. E. Sirrine Co.): I was just wondering if Mr. Brumley has any information on the shrinkage he gets with his sequence of bleaches, or would he want to give it to us?

MR. BRUMLEY: Mr. Hughes, we would not like to make any statement on that point at this particular stage of our opertion. We do not feel that we have operated a sufficient period of time to have figures which we could pass on with any degree of reliability. You will hear in general discussion the two different theories. One is that you get a higher yield using chlorine dioxide, and the other is that you are removing the same noncellulose material, regardless of what bleaching material you use, and consequently there isn't a great deal of difference.

We may have some discussion on those two theories.

CHAIRMAN RAPSON: Would anyone else like to comment on the difference in shrinkage caused by chlorine dioxide, as compared with hypochlorite? (No one responded.)

Does anyone have any information on that point? (No one responded.)

One difference, of course, is that the hypochlorite is carried out on the alkaline side, and the chlorine dioxide on the acid side. The hemicelluloses are more soluble on the alkaline side. Otherwise, I would not expect any difference.

MR. SCHUBER: We have just laboratory data on that, and it is very difficult to say that the mills will do likewise, but I feel certain that we have translated our laboratory data into manufacturing data so well in the past that I trust it will continue in the future.

Our laboratory data distinctly show that without hypochlorite and with chlorine dioxide there is a noticeable improvement of yield in favor of chlorine dioxide.

CHAIRMAN RAPSON: What to you mean by "noticeable"? One per cent?

MR. SCHUBER: $1^1/_2$ to $2^1/_2$%—sometimes more.

CHAIRMAN RAPSON: Is that percentage on pulp?

MR. SCHUBER: That is percentage on pulp yield. In other words, there is a $1^1/_2$% difference. If you have a shrinkage of 7% normally with hypochlorite, on the average you will come out with a 5% shrinkage using chlorine dioxide.

CHAIRMAN RAPSON: You are referring to shrinkage on the basis of unbleached pulp?

MR. SCHUBER: Yes, on the basis of unbleached pulp. All of our figures are based on unbleached pulp.

BEN HOOS (Brown Co.): I would like to have the panel make some comments about the relative effect on the woody specks or resinous specks with chlorine dioxide bleaching and hypochlorite bleaching.

MR. BAKER: That's the question that influenced us in the use of chlorine dioxide, rather than the normal hypochlorite bleach plant. Our mill is set up to use sawmill waste, and naturally you get a much higher percentage of knot fragments, bark, and so forth, and we have a rather high shive count before the chlorine dioxide stage, but after the chlorine dioxide stage it is very much reduced.

The only trouble we do have is with the very hard burned

knots, the wood which is burned in the digester, or fire damaged wood which acts as char.

Of course, anything that is not lignin or coloring material is not attacked by chlorine dioxide, but all lignin material is very well bleached out.

MR. LEE: Being a sulphite man, I am very sorry that I don't hear any reference to a sulphite installation. Is there anybody here who has any information on this subject?

CHAIRMAN RAPSON: Thank you very much! I hope Eric Ericsson is here—Eric Ericsson, general superintendent of Puget Sound Pulp & Timber, who is using chlorine dioxide and sulphite.

E. O. ERICSSON: At Bellingham we have a four-stage bleaching system composed of chlorination, caustic extraction, hypochlorite, and chlorine dioxide. The chlorine dioxide is to bring the pulp from a brightness of about 80 to a brightness of 90 to 91, and our experience has been very good. There has been no problem in the use of chlorine dioxide for dirt.

I would think that the dirt is about the same for chlorine dioxide as it would be for hypochlorite. Our brightness ceiling is higher for chlorine dioxide. Our brightness ceiling was 88 to 89. Now it is 90 to 91, or higher.

We use about 10 lb. of equivalent chlorine as chlorine dioxide per ton of pulp.

CHAIRMAN RAPSON: That's a very small amount. That is about 0.2 to 0.25% on pulp, is that correct?

MR. ERICSSON: Yes. I don't know whether that answers the question. Do you have something else?

MR. LEE: I was interested in shives.

MR. ERICSSON: Compared to hypochlorite, I just couldn't tell about that. We have Centri-Cleaners and screens which affect the dirt results, so I don't know that I can particularly answer that question in regard to shives.

MR. LEE: Would you care to say a few words on the increased cost?

MR. ERICSSON: We use so little chlorine dioxide that I really couldn't tell you about that.

CHAIRMAN RAPSON: I should think it would be hard to find a difference in cost if they only use 0.2 to 0.25 chlorine dioxide. Their bookkeeping system wouldn't even show that up.

What is the retention time in your chlorine dioxide stage, Eric?

MR. ERICSSON: It's $2^1/_2$ hr.

CHAIRMAN RAPSON: Thank you very much, Eric.

Now, are there any other answers related to anything brought up by the panel?

MR. TOMLINSON: I would like to ask about the use of caustic or sulphur dioxide in neutralizing the chlorine dioxide in the washer vat, if anybody has any opinions, where they have used both, or chosen one against the other.

CHAIRMAN RAPSON: I am going to ask Chick Hartford to answer that question.

MR. HARTFORD: We started using caustic to neutralize the residual chlorine dioxide, and most of our experience has been with the use of caustic.

However, recently we have started to use sulphur dioxide, and we are studying the use of sulphur dioxide compared to caustic as to the effect on reversion. We have not yet come to a final conclusion on that matter; the study is still in progress.

CHAIRMAN RAPSON: Thank you, Chick.

Now, we are just getting nicely into this discussion, and I would like to ask other members of the panel to comment on this point. It is a contentious one. So far we don't seem to have any conclusive opinions.

George, have you anything to say on the comparison of caustic and sulphur dioxide? (Mr. Brumley had no comment.)

MR. WHELESS: We have only used caustic, so I can't tell you.

CHAIRMAN RAPSON: Don, have you anything to say about that?

MR. BAKER: As I mentioned, we use caustic as a normal operating method, but we did try for about a 2-month period using sulphur dioxide as an antichlor; but owing to our sequence, it was necessary after the use of this sulphur dioxide to add further caustic to raise the pH for the subsequent stages.

It therefore became very expensive, and during the period of use we were not able to detect any significant change in the rate of corrosion on the washer. That would be the first chlorine dioxide stage washer.

However, I don't believe we gave this a fair trial, because we were too much prejudiced by the high cost we were running into, and our estimate was that it would be cheaper to take the high corrosion rate on the washer, and maybe by the time that washer eas ready to be replaced, there might be some synthetic coating that could be applied to reclaim that washer or extend its life. So we are still in that position.

CHAIRMAN RAPSON: Thank you very much, Don. I hope the equipment manufacturers are listening, and will produce such a washer in the future.

Notice the boldness of comparing the costs of dissolving washers and chemicals! If more people would pay attention to this, we wouldn't be so afraid to use corrosive materials.

MR. HARRISON: Well, there is no question about it. The safest way is caustic, but last year in our talk we showed where we killed in one case with caustic and in the other case with sulphur dioxide, and generally speaking the sulphur dioxide test results showed about 1 brightness point higher.

CHAIRMAN RAPSON: Thank you. What do you mean by "the safest"?

MR. HARRISON: From a corrosion point of view.

CHAIRMAN RAPSON: From a corrosion point of view the caustic is the safer, but there is some question as to whether or not the sulphur dioxide might not have improved the brightness.

I would like to say here that I have observed very frequently that any change of pH through the neutral range has brought about an improvement in brightness. You will notice that Don was bringing the stock through the neutral range up to the alkaline side, and in every case people seem to get some advantage from that change which occurs right within the fiber wall itself.

MR. HOOS: Will you please describe the conditions under which you made the bleaching tests that you had on those charts showing the relationship between brightness and pH on chlorine dioxide bleaching?

CHAIRMAN RAPSON: The density was 6%, the time 3 hr., the temperature 60°C., with pH fixed at the chosen level by means of buffers.

MR. SCHUBER: We have done similar work and verified your results. That is, we got the same results, whether they are verified or not.

We did our work at 12% consistency, and we find the pH range of about 5.4 will give us the best results.

CHAIRMAN RAPSON: Our selection of 6% consistency arose from studying the effect of consistency. We could find no difference in the effect on the pulp between 12% and 6%, and it is easier to work with on the laboratory at 6%. However, I am sure that the results can be extrapolated to 12%, but not much higher, because, as was shown this morning, when you get to the higher consistencies, there is not enough water to hold the chlorine dioxide in solution.

MR. SCHUBER: If you do it in a totally enclosed cell, I think it makes difference, and I don't agree with you there.

CHAIRMAN RAPSON: I think that may be true, although to my knowledge nobody in the world is using a consistency higher than 12% in any mill. Do you know of anybody who does?

MR. SCHUBER: I would have to address that to the mill people in the audience.

Mr. Hartford: We operate at 10%. We have not operated above 12% for any appreciable length of time.

Chairman Rapson: Has anyone else? (No one responded.)

If not, we can take it that there isn't anybody here at least who knows of anyone operating above 12% consistency with chlorine dioxide.

Mr. Kuhe: Has anybody had any experience on the use of chlorine dioxide on neutral sulphites in semichemical pulp in hardwood bleaching? First, in the mill.

Chairman Rapson: "No comment" says Ward Harrison. Any others who would like to comment? (No one responded.)

Secondly, then, in the laboratory. Is nobody using chlorine dioxide on semichemical pulps in the laboratory?

Mr. Schuber: We have for very many years, and I think shortly that probably will be translated into practice—I hope. Our results have been excellent.

Chairman Rapson: Thank you, John. We seem to have been working along parallel lines in many respects. I have had an investigation going on for some time on the use of chlorine dioxide on semichemical pulps. It works very well. We can get just as high brightnesses, or even higher, than with hypochlorite, very simply; but we don't have the results out yet on the effect on strength.

My expectation is that we will not lose any strength with chlorine dioxide, but will develop more strength than we had in the unbleached pulp.

Mr. Schuber: I think that's true, because all our results show that.

Chairman Rapson: Fine! Any other questions? (There were none.)

I would like, then, to direct the questions along the lines of what does chlorine dioxide do to the various factors in which we are interested. We have already discussed the effect of chlorine dioxide on dirt. We haven't said very much about ultimate brightness. Some good figures were shown us this morning.

Some have said that on sulphite pulps you get as high as 90, 91, and perhaps even 92. On kraft pulps we have heard of a 90 brightness ceiling, but the only ones who mention that are the ones who are using two stages of chlorine dioxide. Those using one stage are operating around 86, 87, and sometimes 88% brightness.

I would like to ask our panel members, those who didn't already comment on that point, what sort of brightness they get with chlorine dioxide.

Mr. Wheless: At the present time we are bleaching to 83 to 85 brightness. That's because that is the brightness we want. I think without undue cost we can, with our system, go as high as 87. Above that I think it would begin to cost us more money than we are spending now.

Mr. Hartford: We bleach in the range of 85 to 87, and at the rate at which we are operating and the equipment which we have, I don't believe that we could bleach much higher than that on a pine pulp. Perhaps we could get up to 88 on the gum.

Chairman Rapson: Thanks, Chick.

Now, George, what do you think you could ultimately get out of your system?

Mr. Brumley: Well, Howard, that's the $64 question. We have not really operated a sufficient period of time to have sufficient data as a background to truthfully answer. However, we can state what we have done up to this point.

We operate with a routine control of 87 to 87½ in brightness in our fifth stage. Upon numerous occasions we have operated up to 90 brightness out of that fifth stage.

Frankly, we were not trying to operate at the 90 brightness range when we achieved those brightnesses. (Laughter.) By that I mean that we have had no occasion to try to operate up in that range. Our routine control is in a range that we feel is satisfactory for the demands of our output.

Chairman Rapson: Thanks very much, George.

Don, you commented on that point very well when you described your bleach plant.

Is there anyone in the audience who would like to comment on the maximum attainable brightness with chlorine dioxide bleaching? (No one responded.)

I would just like to say that there are dissolving pulps on the market, of course, which are in a different category, that have a brightness of 95%.

The next question I would like to address to our panel is: What is the effect of chlorine dioxide on the fiber properties for papermaking? For example, what effect does it have on beating properties of pulps?

Mr. Hartford: We have not made any comparison in our mill of the effect of chlorine dioxide compared with hypochlorite bleaching on the beating properties of pulps. I don't believe I am qualified to answer that question.

Mr. Wheless: The only comment I can make is that, so far as beating time in a laboratory beater is concerned, we have found no special significance to the lowering of the time.

Chairman Rapson: What about opacity? Is there any effect on opacity?

Mr. Wheless: We have found in our experience a slight lowering of opacity.

Chairman Rapson: George, have you noticed any effect on opacity?

Mr. Brumley: Well, we feel that there is a relationship between the ultimate brightness of your pulp and opacity. The higher the brightness you move to, the less opaque will be your ultimate product. That's our feeling.

Chairman Rapson: Has anyone in the audience anything to say on the effect of chlorine dioxide on beating properties, fiber characteristics or on opacity or anything of that nature? (There was no response.)

Has anyone noticed any effects of chlorine dioxide on machine operation? I have heard it said that when some mills have switched over to chlorine dioxide they noticed some changes in machine properties or sheet properties? Does anyone in the audience have anything along those lines? (No one responded.)

We have discussed fairly well the effect of chlorine dioxide on reversion, which is a very important matter. Now I want to turn to another section of chlorine dioxide work which is very important, and that is corrosion. I would like to ask the members of the panel what their experience is with various materials of construction with chlorine dioxide.

The first one we naturally think of is stainless steel. What have you noticed with respect to the effect of chlorine dioxide on equipment made of 316 or 317?

Mr. Hartford: Our final washer, which handles the pulp from the chlorine dioxide tower is made of type 316 stainless steel, and we have had very good success with it. There is very little indication of corrosion in that washer.

Mr. Baker: We have a mixture of both type 316 and type 317, but the thing that baffles us is that in the washer drum itself, which has been built from type 316; in one case, and 317 in the other there will be some areas that have been badly attacked, and adjacent areas that are not attacked at all.

The same thing holds true in pipelines. Of course, the major amount of the attack is around the welds, but nevertheless there are spot attacks in the plate which are almost inexplicable. You wonder whether there has been some surface defect in the rolling of the plate, or some area of metal that is defective.

We are now of the opinion that everything made of stainless steel must be thoroughly polished, blasted, and pickled.

Chairman Rapson: Your original washers have been operating now for 4 years, have they not?

Mr. Baker: That's right.

Chairman Rapson: How are they standing up in general, and what do you think of their life expectancy at this point?

Mr. Baker: Well, several years ago we were very alarmed. We thought we were going to have a very short life on the washers, but since that time we have had a regular practice at every opportunity, particularly when the deck wires are changed, of sandblasting the deck, or shorblasting, and then thoroughly acid pickling all parts we can get at. That does seem to slow down the attack.

In some cases the pits will stay bright, showing that there is no more corrosion on these pits. Once corrosion pits or carbuncles develop, they seem to spread very rapidly as a rule, however.

As to how long the equipment will last, that is a difficult question to answer. I have to do some figuring to give a really intelligent answer, but I think we should be able to look forward to another 5 years without too much worry.

Chairman Rapson: Thanks very much. That was the point I wanted to bring out—that it looks as if at least 9 or 10 years might be the life expectancy of such a washer. This is a problem that has been bothering people a great deal. You don't want to put in new washers every year.

Now, what about Hastelloy C? What has been your experience, Chick?

Mr. Hartford: We have used Hastelloy C in the mixer where we mix chlorine dioxide with the pulp and at the same time introduce steam. Our first mixer was a brick-lined tank having a steel agitator covered with $^1/_8$-in. Hastelloy C plate. The Hastelloy failed after about 1 year.

We next tried a mixer having a steel shell lined with $^1/_8$-in. Hastelloy C and having a solid cast Hastelloy C agitator. The shell lining failed after about 1 year.

It is our feeling that the shell as well as the mixer should be solid, if you are going to use the Hastelloy C.

Chairman Rapson: What are you using at the moment?

Mr. Hartford: We are still using the lined shell at the moment.

Chairman Rapson: Thank you very much.

Has anyone else any experience with any of these metals we have been discussing?

H. O. Teeple (International Nickel Co.): I am very much interested in the comments that the panel has made with respect to corrosion-resisting characteristics of these alloys. I wonder if I might take a couple of minutes simply to review this situation in general?

The difficulty with corrosion in chlorine dioxide is the fact that you are handling acid and chloride, in one way or another, which are oxidizing. Fundamentally, this is quite destructive to the austenitic stainless steels. The reason is that this acid chloride film is quite potent in causing a breakdown of the oxide film on stainless.

This can be modified by using the molybdenum bearing stainless steels, such as type 316 or 317.

The experience, to date, indicates that there are several ways in which this problem can be alleviated. Number one is looking at this from the standpoint of the metal supplier, or perhaps the equipment manufacturer. Extreme care must be used in choosing the material of construction. Also, extreme care must be used in the fabrication of the equipment.

A quick illustration of the latter effect is in the matter of stock lines, which are made up by welding sheet. Since this pitting attack is known to occur in crevices or under deposits, such as Mr. Baker mentioned, if you do not get 100% penetration of the weld, you naturally start out with your stock lines with built-in crevices, so to speak. Stock can hang up, and you can get severe pitting under the stock and in the crevice formed by the weld. So, you have an aggravated situation.

One way to correct that is to, perhaps, utilize a weld rod of somewhat greater alloy content in the welding of the stainless. Our experience has been that the extra low carbon varieties have better resistance to a localized attack than the normal carbon, and furthermore, we have found that 317 is somewhat superior to type 316 in that respect.

So, it would seem, in general, that the 317 would represent a fairly good material to use in construction. However, by going to 317, you are not out of the woods with the corrosion problem. It still can happen, except that you probably will gain an economic extension of service life.

One way in which the mill people can assist in alleviating this corrosion problem is to do what Mr. Baker has indicated, namely, to pay particular attention to the condition of your equipment, to keep it clean, to keep the film deposits, or scale, or other sorts of deposits, removed from the surface. This should help in prolonging the service life.

I am very pleased to note that Mr. Baker seems to think that the stainless washers will last something on the order of 8 to 10 years. I think that is very economical service for stainless in this particular sort of a service.

With respect to Hastelloy C, one would think that the alloy should work very well. One difficulty is that it is quite expensive. Nevertheless, it is true that there are places where the Hastelloy C can do a good job.

However, I wish to point out that Hastelloy C is not the full answer, because care must be used in this very corrosive environment. The normal use of Hastelloy C is not for this very corrosive application.

In this particular situation I think it would be well for you folks to consider, as a proper solution, heat treatment. My experience with Hastelloy C in this field has indicated more times than not, perhaps, that the trouble encountered is due to some sort of a lack of appropriate heat treatment following fabrication.

While I am up here, Mr. Rapson, I would like to inquire of our Swedish friends what their experience has been with the use of stainless and other alloys in handling chlorine dioxide.

Now, before I leave, I should like to suggest to the audience that for these very corrosive environments, wherever it is possible to do so, to use plastic materials which are currently available. However, we recognize the fact that you cannot use plastic for all pieces of equipment associated with chlorine dioxide.

Chairman Rapson: Would you like to comment on what is being done?

Mr. Scholander: I have no experience in that.

Mr. Dahl (Kamyr): I think, regarding the life expectancy, there is a chlorine dioxide washer in Sweden made of stainless steel which has been operating since 1946. It is made of 32-SK, which is somewhere between 316 and 317, and that has been running since 1946.

I would like to point out that it is working under a hot condition, and it still stands up since 1946 with that material, and that should correspond somewhat with Mr. Baker's thoughts on the life expectancy of stainless steel washers.

Chairman Rapson: May we ask your experience with respect to the wire, other than the washer?

Mr. Dahl: That I cannot say.

Chairman Rapson: And what is the condition of the washer now? Do you know, Mr. Dahl?

Mr. Dahl: I haven't been home for a year, but from what I hear it is still working there, and it seems to be reasonably good, although I might be wrong if I said anything else, and I don't want to take that chance.

Mr. Baker: I hesitate to talk optimistically about the washer wires, because if there are any representatives of the washer wire manufacturers here they won't be very pleased to hear what I am going to say. The Kamyr washer that Mr. Dahl is speaking of is quite differently designed and built from the Impco. The one I saw had a solid deck of about $^5/_8$-in. stainless steel plate.

Our washers are the standard type of washer with division ribs and a winding wire, but with the winding wire we have had exceedingly variable experience. We have had them go in 1 month, or had them last as long as 8 months. At each

point where the winding wire crosses an intermediate or division rib, a point of attack or corrosion cell develops.

The face wire stands up fairly well, anywhere from 6 months to a year, normally, but it, too, goes at the point of contact. There seems to be a kind of oxygen cell corrosion.

We hold our wires on the washers by bands, and the washer wires are usually fairly heavily attacked underneath the bands. If we can work out a solution to the deck wire, we will certainly be very happy; but nobody whom we have talked to yet has been able to give us what we would call a satisfactory solution.

MR. HARTFORD: I can't give specific wire life on our chlorine dioxide washers, but I can say that, in general, our experience has been satisfactory. We have not had the same sort of experience that Don has just described. We have what I would consider a satisfactory experience with the wires on the chlorine dioxide washer.

MR. WHELESS: We have only been operating our washer—which is 316 stainless—for about 4 months on chlorine dioxide, but I had occasion to change the wire about a week ago, because of mechanical damage to the wire. I was expecting, as Don Baker said, to find corrosion where the winding wires crossed the divisions, but I could find no evidence of that.

The only corrosion that I found on that washer was underneath the bands, as he said, on the winding wires. There was some slight corrosion in the welds between the division sections on the deck.

MR. SCHUBER: I would say this. I don't know a thing about corrosion, but it seems to me that there is a point lacking in the results that people are getting in corrosion. I think it is due to how much residual chlorine you have in your chlorine dioxide cell, as well as how you neutralize and how well you neutralize.

MR. TOMLINSON: We did some work a few years ago on that point, and if you add sulphur dioxide to chlorine dioxide, chlorine dioxide is destroyed, so if you are using that system, then your corrosion at the washer would be from sulphuric acid and sulphur dioxide.

If you add caustic to the small residual that you would normally expect from such a stage, the color within the pulp changes from yellow to colorless, indicating that you have lost your chlorine dioxide, and it's gone over to sodium chlorite. Therefore, when there is corrosion at the washer, would that mean that the correct conditions are not faithfully held at the washer—that is, is there a neutral pH in the one case, or excess sulphur dioxide, or would it be that it is variable?

Does it mean that sometimes the sulphur dioxide is on and off, and sometimes the caustic is on and off, and that the conditions are not so good? Do we need super control, really, at that point, if we are going to keep corrosion under control?

MR. HARRISON: I can't answer that *per se*, but I have seen this corrosion situation at Harmac, and we have watched it at our mill, and there is something different about those other plants. I can't tell you what it is. I don't know anybody who can tell you what it is.

Harmac has a serious problem. I saw some pitting of pipe at Camp earlier, and we haven't had that. It really can be a serious thing, and I don't know what the answer is.

Now, we have used both sulphur dioxide and caustic, so our particular system isn't sensitive to either one of them. I don't mean to infer that we don't have any corrosion at all, but the corrosion we have is mighty small, compared to some other corrosion that we have seen.

CHAIRMAN RAPSON: Do you have a pH meter on that white water system to keep it under very accurate control?

MR. HARTFORD: We check our pH manually at frequent intervals—half-hour intervals.

CHAIRMAN RAPSON: It would seem, then, that Mr. Tomlinson may be right, that control is very important, to keep the pH very accurately on the chosen level. I wouldn't be surprised if that's the answer.

Any other comments?

MR. SPROULL: I would like to ask the gentleman from International Nickel if Carpenter 20 has been tried in this application.

MR. TEEPLE: Carpenter 20 has been used, or alloys of that general level of alloy composition, but the peculiar thing is that the additional alloy content does not necessarily improve the pitting resistance.

We have noticed in bleach situations as well as in other environments where pitting is the primary concern, that while the frequency of pitting may not be quite so great as it is on a straight 316 stainless, the intensity of pitting, however, seems to be slightly greater.

MR. P. H. GLATFELTER: I'd like to ask if any members of the panel use calcium hypochlorite in the stage preceding the chlorine dioxide.

CHAIRMAN RAPSON: No, the panel members unanimously use sodium hypochlorite.

MR. GLATFELTER: Did any of them switch?

MR. BAKER: Our first hypochlorite stage is calcium base, and the second caustic, which is sometimes operated as hypochlorite, was calcium base when operations first started. We were troubled with scale formation in the tower and washer vat, and blinding of the washer face wire. We switched over to sodium-base hypochlorite in this stage (when used as a bleach tower) and the scale problem was much reduced. As scale formation is still a major problem at Harmac, I would like to ask the audience if this is a general problem or not.

MR. GLATFELTER: We have the same problem. That's the reason I asked. If you operate in the neighborhood of pH $5^1/_2$ to 6, I am wondering if anybody has any information on the residual chlorine dioxide affecting the corrosion of the washer at that pH.

CHAIRMAN RAPSON: Has anyone operated a washer at pH 5 to 6 with some residual chlorine dioxide? (No one responded.)

W. J. VERROSS (West Virginia): We have been operating a pilot plant with chlorine dioxide since 1948, and we have 30 by 16-in. medget washers. The first washer was a neoprene-covered, with a 16-in. face wire, and the neoprene lasted about 3 years.

CHAIRMAN RAPSON: Is that plant operated continuously?

MR. VERROSS: Seven days a week, 24 hr. a day.

CHAIRMAN RAPSON: That is on chlorine dioxide?

MR. VERROSS: That's right.

CHAIRMAN RAPSON: On what kind of pulp?

MR. VERROSS: All kinds. At the same time we have never used any neutralization.

We are only on our third wire since 1948, and the reason for the third one is because we replaced the washer last year with a nitrocoated washer, and we had to put a new wire on it, and that one is still operating.

At the same time we put in in 1949 a Hastelloy C mixer, replacing a ceramic mixer, and that one is still there.

We also added to that a Hastelloy complete pressurized mixer and agitator, and that one is still there.

CHAIRMAN RAPSON: Is West Virginia using chlorine dioxide in the mill?

MR. VERROSS: They are going to pretty soon.

CHAIRMAN RAPSON: It apparently takes a long time in the pilot plant stage; 1948 to today!

MR. VERROSS: That's right.

MR. WHELESS: Ward Harrison made a comment just now, that he had seen corrosion in our 316 stainless piping, and I think we can definitely point out that that is poor fabrication. One very good reason for my saying that is the fact that the shop welds are the ones that are pinholing, and the field welds are holding up much better than the shop welds.

That has happened not only on the chlorine dioxide piping, but I have noticed some of it in the hypochlorite stock lines too, so I have the feeling that that is poor fabrication and poor annealing, and we are getting carbide pitting in those joints.

A very small thing on Hastelloy C that I might say is this. We had all our hypochlorite flows fed through transmitting rotometers, and we had a terrible time keeping the floats in those rotometers. They would corrode apart where the rods are screwed into the float proper. They were made of Hastelloy C and I had one heat treated and annealed afterwards, after it was threaded, and that one has held up for 6 or 7 months now with no evidence of corrosion, whereas before in 3 months they would corrode apart.

So, I think this heat-treating and annealing is probably a most important factor.

Chairman Rapson: I would like to change the subject from corrosion now to one or two other points. One is safety.

We had a very good paper on laboratory results with chlorine dioxide this morning. I would like to ask the panel how frequent are puffs in the bleaching towers.

Mr. Hartford: I like the use of this term "puff."

We had one puff in our bleaching tower in the early days of the operation of the tower. It was not a serious explosion. No appreciable damage was done. It blew the packing out of the tower that is used to seal off the top of the bleaching tower, but other than that no damage was done, and we have had practically no trouble of this sort, I would say, in the past 2 years.

Mr. Wheless: So far as I know we have never had a puff in the bleaching towers themselves.

Mr. Brumley: We have had no difficulties with puffs or explosions in the bleaching towers. The only puffs that we have had have been in the chlorine dioxide preparation system, from the reactors—which are literally puffs. That is, no explosion of any consequence.

Mr. Baker: We have had an occasional puff in the bleaching tower, but it invariably occurs around start-up time, and we have usually blamed it on excessive steam flow when we are heating the stock up, and a great deal of steam is used, and the chlorine dioxide flow is also rather heavy. Before we heard others' experience, we considered it was just excessive steam-flow pressure, because it used to blow the cover off the tower, and all we had to do was replace the cover and start off again. It gave us no trouble.

Mr. Brumley: You listened to the paper this morning, of course, on the matter of concentrations of chlorine dioxide. The only comment that I might make of interest is that we, of course, in handling all of our bleaching by chlorine dioxide —we have higher concentrations than some of the other plants.

In our operation we know that we have been up to 1% ClO_2 in the towers, and still have had no explosion problem.

Chairman Rapson: Thank you, George.

Has anyone else had any experience with chlorine dioxide puffs in the bleaching towers? (There was no response.)

The main point of bringing up the puffs is to show that even where they do occur they are not serious, and it is very nice to have this direct experience of the panel members. You must have learned how not to have these explosions from the fact that they are very uncommon now.

What conditions have to be maintained to prevent such explosions?

Mr. Hartford: The one experience that we had, we attributed to the same reasons that Don mentioned. That is, it was during start-up time, and we were feeding steam at a pretty heavy rate, and also the chlorine dioxide solution, and we think that you can prevent these puffs simply by controlling the rate of addition of the chemical and the steam; by controlling those addition rates carefully.

Mr. Tomlinson: I would like to ask if there is any special control, so that when the stock should stop flowing for any reason it will automatically shut off the chlorine dioxide or steam, or both.

Mr. Brumley: Our system is designed so that the chlorine dioxide and the steam no longer enter the system if the stock stops flowing.

Mr. Baker: We still have manual control. The operator must shut off the steam and also the chlorine dioxide, and occasionally we will get a puff if the stock flow stops for any unscheduled reason.

Mr. Wheless: We are using manual control for that too. Our system is a little different, in that we put our steam in a mixer, so that when the stock flow starts you are not mixing chlorine dioxide and the steam, In that particular case, however, it is up to the operator to shut it off if anything should happen.

Chairman Rapson: Has anyone noticed a reversion in the color of chlorine dioxide bleached pulp, if the chlorine dioxide becomes exhausted and heating is continued in the tower? There was a little hint of that. Has anyone noticed a reversion?

Mr. Hartford: We haven't checked that particular point. We do normally get reversion of around 1 point, but we haven't checked the specific point that you mention.

Mr. Wheless: I can't answer that all the way, but recently we have had occasion to run our plant at a capacity of around 50 tons a day, so that has meant that we were down upon occasion 16 hr. and running it 8, and we would notice no reversion in color from sitting in the tower that length of time. Of course, no extra heat was added either.

Mr. Brumley: It is our feeling, and we cannot substantiate it by actual laboratory or operating proof, but based upon our observation we feel that a slight reversion may take place if your chlorine dioxide residual is lost. However, we feel that it is a slight reversion.

Mr. Baker: In our experience, if we have no residual when the pulp comes to the washer, then we are not certain whether we have added sufficient chlorine dioxide in the first place, so it is difficult to say whether reversion has taken place, or whether we have insufficiently bleached in the first instance.

Kenneth C. Logan (Northeastern Paper Products): The comments from the panel were in relation to color reversion, I believe. Have any of them studied strength reversion on long storage with chlorine dioxide?

Mr. Brumley: We have had occasions when there were stoppages in the plant due to mechanical failure of equipment, in which pulp did stand in chlorine dioxide towers, and it is our feeling that the strength lost during 24 or even 48 hr. retention time in those towers was very slight.

Mr. Clarke: Have you ever shut your mill down on a holiday? You know, it takes about 24 hr. to pull out a normal bleach plant, so your pulp doesn't rot. Are you able to save that time and keep running right up to the last minute, when you are using chlorine dioxide?

Mr. Baker: We have on occasion been down as long as a week. We have never noticed any loss in strength or in viscosity.

When chlorine dioxide towers are prepared for a shutdown we usually cut the chlorine dioxide off half an hour ahead of time, so that there isn't nuisance gassing. We have found some loss in color, but no appreciable loss either in strength or viscosity.

Chairman Rapson: We have covered quite a broad field. We have been very fortunate in having the panel we have, but I don't want anyone here to leave the room with a feeling that there is a question in their minds that has not been answered.

Is there anyone who has an additional question they would like to have answered before we leave?

Mr. Tomlinson: When you add chlorine dioxide to pulp in varying amounts, we'll say 0.5, 1, or $1^1/_2$%, to pulp that is already fairly well bleached, you will consume about 80 or 90% of the bleach that is added, regardless of the amount added. In other words, you are not consuming it on lignin,

so it may be on carbohydrates. At least it seems odd that you would consume so much.

Does anyone know what the reaction is that goes on there?

CHAIRMAN RAPSON: Nobody seems to want to answer that question. Does anybody in the audience want to answer it? (No one responded.)

Well, George, you have a good research department. Will you please find the answer to it and give it to us next year?

MR. LEA: You mentioned the use of chlorine dioxide in the production of dissolving pulps on sulphite pulp. Can you tell me at what stage you control the viscosity? It isn't in the chlorine dioxide stage, is it?

CHAIRMAN RAPSON: No, the viscosity has to be controlled by hypochlorite, because the chlorine dioxide won't degrade the pulp.

MR. BISHOP: Most of these chlorine dioxide stages that have been presented by the panel were preceded by three or four stages. In most cases there was a caustic extraction immediately prior to the last chlorine dioxide. I wonder why Camp is not using caustic extraction. Was it that your brightness level was already sufficiently high?

MR. WHELESS: Well, we found that it was doing us practically no good. We were using very little caustic, of course, but it made a difference in the permanganate number with and without caustic on only an average of not more than 0.1 of a point, and there was no difference in viscosity or color.

MR. BISHOP: Well, further along that line, I wonder what amount of benefit St. Mary's feel they get where they are double staging chlorine dioxide and using caustic in between.

MR. BRUMLEY: Fred, I would rather answer that by saying that we don't say that you do or you don't. We are merely stating that that is the operating procedure we are using at the moment. Maybe next year we will have a more definite opinion on that particular point.

CHAIRMAN RAPSON: Perhaps I can say something about a laboratory investigation on that point. If you are talking about 85 to 87 brightness, I think perhaps you could leave out that caustic stage, but if you are looking for the ultimate top brightness that you can possibly get in the pulp by any means whatever, then the caustic stage gives you a little increment in brightness.

MR. BISHOP: It probably accounts for his 90 brightness on occasion.

CHAIRMAN RAPSON: It could. All he has to do is find out how to do it all the time!

MR. SCHUBER: In fact, in the laboratory we have found that the caustic extraction in certain grades of pulp and certain treatments, can increase the brightness of the pulp 2 or 3 points. We can get a higher level of brightness.

MR. LOGAN: We have heard that there has been very little degradation from chlorine dioxide bleaching in the case where you have no hypochlorite. Is there any chance that you might have adverse customer reaction from some customers due to lack of degradation?

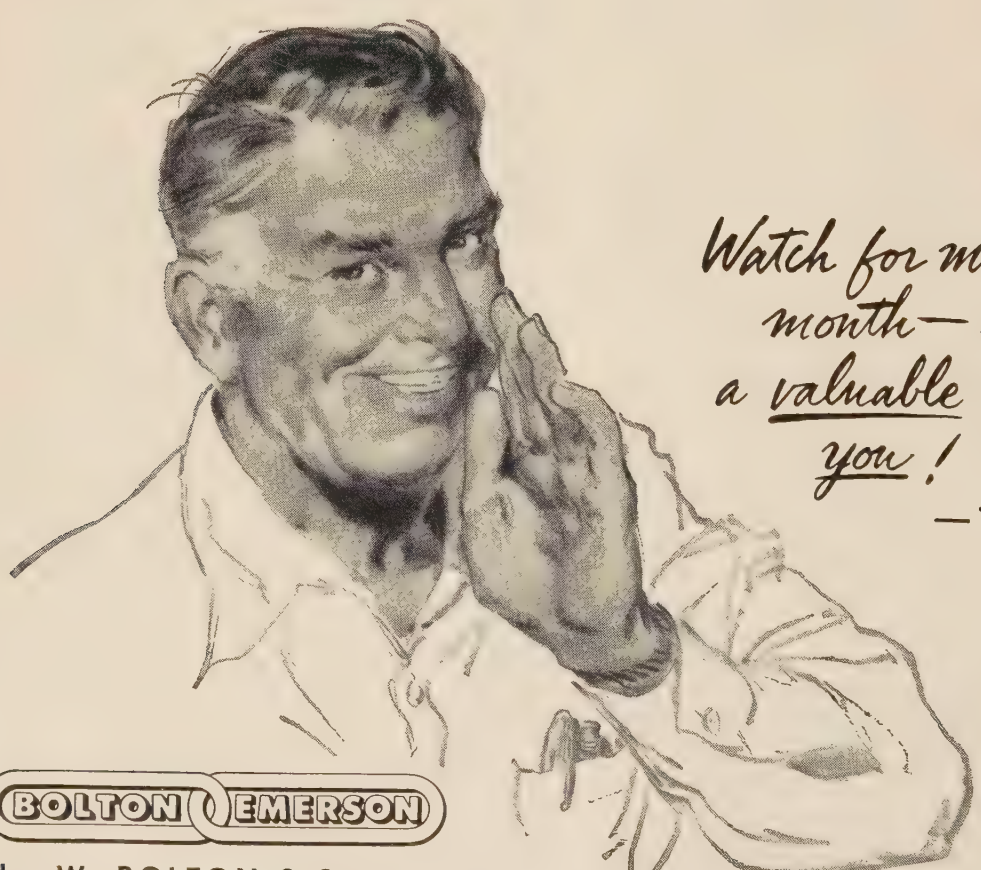
CHAIRMAN RAPSON: I am not going to designate anybody to answer that, but if we have a volunteer, I'll take it. (No one responded). We are treading on dangerous ground when we speak about customer reaction!

Are there any customers present who would like to react? (No one responded.)

Ken, I'm afraid we can't get the answer to that question here. Any other questions? (There were none.)

Then I would like to express my appreciation as chairman of the Pulp Purification Committee to the audience we have had this morning.

I would like to express my appreciation to the members of the panel who so kindly consented to come here and stand this barrage of questions. I want to thank them individually and collectively for taking part in this discussion. The meeting stands adjourned.



Watch for me next month—I'll have a valuable tip for you!

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UNITED STATES PATENTS ON PAPERMAKING

Second Quarter, 1955 — *Compiled by The Institute of Paper Chemistry*

The following list of United States patents has been compiled from the current numbers of the Official Gazette of the United States Patent Office. Because, as a rule, only one claim is published in the Gazette, it is not claimed that the list is complete; also, it is possible that the list may contain some patents that do not apply specifically to pulp and paper manufacture. Copies of any of the following patents may be obtained fro the United States Patent Office, Washington 25, D. C., by sending twenty-five cents for each patent desired.

April 5, 1955

Bencowitz, Isaac. Sulphur atomizer and burner. U. S. patent 2,705,671. Filed May 8, 1951. 9 claims. Assigned to Texas Gulf Sulphur Co. [Cl. 23-278.] By the system claimed, operative by means of an air vortex established just above the surface of the bath, efficient atomized sulphur combustion is conveyed upwardly through a riser for distribution to any subsequent processing channels.

Brenner, Morris. Card package and shuffling device. U. S. patent 2,705,555. Filed April 17, 1950. 10 claims. [Cl. 206-46.] The device claimed comprises a pair of complimentary forms of suitable plastic material (glassine or the like), each of which is adapted to hold a portion of two packs of playing cards in such a manner as to facilitate their manual handling and shuffling.

Cipriano, John F. Photosensitive paper base material and method of making same. U. S. patent 2,705,685. Filed Nov. 25, 1952. 12 claims. Assigned to Adelphi Research and Manufacturing Co. [Cl. 117-34.] Blueprint or similar paper is coated with a fluid aqueous basic aluminum carbonate gel suspension and then dried.

Colby, Jesse L. Means for cutting and sealing plastic bags. U.S. patent 2,705,443. Filed June 4, 1952. 13 claims. [Cl. 93-33.] A cutting means combined with a plastic bag-forming machine is claimed.

Hazeltine, James E., Jr., and Gelzenlichter, Harriet A. Method of making printed felt base floor coverings. U. S. patent 2,705,683. Filed April 10, 1952. 3 claims. Assigned to Armstrong Cork Co. [Cl. 117-14.] Damage to the vinyl resin decorative wearing surface during fusion can be eliminated by providing the particular system claimed, of coating opposite sides of the asphalt-saturated felt base prior to the application of the decorative wearing film.

Hazeltine, James E., Jr. Production of printed floor coverings. U. S. patent 2,705,684. Filed April 10, 1952. 3 claims. Assigned to Armstrong Cork Co. [Cl. 117-15.] The process claimed renders floor coverings curlfree because a plasticizer is retained in the decorative surface film.

Huckstep, Robin C. Chick box. U. S. patent 2,705,588. Filed Nov. 20, 1952. 7 claims. Assigned to Birmingham Paper Co. [Cl. 229-32.] A chick box may be assembled from a slit and scored fiberboard blank.

Kyle, Colin, and Haerther, William W., Jr. Apparatus for forming fibrous articles from pulp. U. S. patent 2,705,442. Filed Dec. 1, 1950. 7 claims. Assigned to Hawley Products Co. [Cl. 92-56.] The fully automatic and cyclically operable machine claimed is used in the production of seamless dish-shaped, porous filter elements for circulatory water systems in combustion engines. Sundry other fibrous articles may be formed, e.g., acoustical members, containers, tropical helmets, etc.

LaBombard, Leon E. Feed mechanism in paper box machines. U. S. patent 2,705,636. Filed April 27, 1951. 6 claims. [Cl. 271-36.] In a conventional feed wheel assembly this invention features two (rubber) frictional elements mounted on the surface of the feed wheel which have adhesive qualities when they encounter the surface of a box blank.

Pidgeon, Joseph A. Folded paper box construction. U. S. patent 2,705,587. Filed June 12, 1952. 3 claims. Assigned to The Budget Press. [Cl. 229-8.5.] A one-piece preassembled coin bank or mite box (for church offerings, etc.) is claimed.

Pomper, Anthony W. Pick tester. U. S. patent 2,705,424. Filed April 12, 1951. 4 claims. Assigned to John Waldron Corp. [Cl. 73-150.] Successive areas of a sheet (paper) are subjected to substantially constant pressure printing with an ink of constant temperature, and accelerating the speed of printing for each successive area, whereby the speed of the first area to show evidence of pick is an index of the pick characteristic of the material.

Ringler, William A. Package for capped articles. U. S. patent 2,705,556. Filed Dec. 3, 1949. 2 claims. Assigned to The Gardner Board and Carton Co. [Cl. 206-65.] A cardboard bottle carrier is provided with cutouts which allow the can or bottle tops to be visible (in order to disclose appropriate brand name or state tax indicia).

Sasse, Elmer C., and Eaton, John W. Paper trimming machine. U. S. patent 2,705,533. Filed May 26, 1952. 5 claims. [Cl. 164-38.] The machine comprises cutters for uniformly trimming one or more corresponding corners on a plurality of books.

Steele, John R. Inclined wall display tray. U. S. patent 2,705,589. Filed Feb. 20, 1952. 2 claims. Assigned to Container Corp. of America. [Cl. 229-34.]

Wille, Karl. Method of coloring cellulosic materials by hot embossing. U. S. patent 2,705,682. Filed May 11, 1951. 11 claims. Assigned to American Cyanamid Co. [Cl. 117-11.] This invention relates to the coating of paper stock (stationery, shelf paper, or decorative paper in general) to obtain tone-on-tone effects, e.g., brown-on-orange, blue-on-purple, etc.

April 12, 1955

Courson, George F. Carton for yarn packages. U. S. patent 2,706,040. Filed Sept. 3, 1953. 2 claims. Assigned to Industrial Rayon Corp. [Cl. 206-65.] A corrugated board partition has an integral core-supporting means which renders positive lateral and vertical support to the yarn packages of each layer in the carton.

Feigelman, Herman A. Folding shipping and display boxes. U. S. patent 2,706,037. Filed Sept. 28, 1951. 8 claims. [Cl. 206-45.11.] Ample and varied display printing surfaces are exposed by the assembled box.

Glab, William T. A method of making a molded lignocellulose product. U. S. patent 2,706,160. Filed June 16, 1951. 2 claims. Assigned to Carr, Adams & Collier Co. [Cl. 106-163.] Finely divided lignocellulose materials are mixed with sulphur particles and heated to 400–600°F. to combine the sulphur and lignocellulose. Upon being heat-treated, the product becomes thermoplastic and suitable for use in further molding procedures.

Guyer, Reynolds. Container opener. U. S. patent 2,706,076. Filed Oct. 12, 1953. 7 claims. Assigned to Waldorf Paper Products Co. [Cl. 229-51.] An inner liner with two weakened lines of separation forms a continuous tear strip extending through one or more panels of the container.

Kreek, Petrus J., and Teunissen, Pieter H. Manufacture of artificial sponges. U. S. patent 2,706,159. Filed Feb. 13, 1952. Issued April 12, 1955. 3 claims. Assigned to American Enka Corp. [Cl. 106-122.] Natural bast fibers are cut to staple length, opened, and treated with a 1% sodium hydroxide solution at 120°C. for three hours until the weight loss of the fibers is at least 20% but not more than 35% of the original weight. The fibers are then washed, dried, willowed, and mixed with sufficient viscose and decahydrated sodium sulphate to permit forming the sponge.

La Grua, James C., and Matthews, Edward G. Paperboard rim for knock-down paperboard containers. U. S. patent 2,706,-074. Filed Oct. 21, 1952. 3 claims. Assigned to National Folding Box Company, Inc. [Cl. 229-5.7.]

Lange, Ludwig H., and Flack, Walter E. Box-wrapping systems. U. S. patent 2,705,905. Filed Aug. 28, 1950. 38 claims. Assigned to Stokes and Smith Co. [Cl. 93-54.2.] The invention relates to a transfer mechanism for automatically, and in time sequence, pulling a box and partially applied wrapper assembly from a transfer station disposed along the path of a wrapper conveyor into the path of the form-block structure of a box-wrapping machine.

Ponts, Joseph H. Bark-peeling tool mounted on pneumatic hammer and reciprocated thereby. U. S. patent 2,705,982. Filed May 3, 1954. 4 claims. [Cl. 144-208.] The portable tool claimed comprises a chisel-shaped member for penetrating between the bark and the wood portion of the log.

Rouan, Francis J., and Bach, John W. Pivotally mounted buckle chute for sheet folding machine. U. S. patent 2,706,115. Filed Dec. 13, 1950. 8 claims. Assigned to Pitney-Bowes, Inc. [Cl. 270-68.]

Springate, Maurice S. Packaging and packs. U. S. patent 2,706,039. Filed Aug. 31, 1951. 6 claims. Assigned to Aviation

Developments Ltd. [Cl. 206-65.] Tubular rivets are packaged by placing the articles in a single row in a tubular container of paper or cardboard. The container is then subjected to transverse pressure causing each article to deform, penetrate, or indent the container.

Tate, Frank E. B. Package of shower curtain rings. U. S. patent 2,706,041. Filed Aug. 17, 1954. 2 claims. Assigned to E. H. Tate Co. [Cl. 206-79.]

Wells, William J. Display and dispensing carton. U. S. patent 2,706,066. Filed July 7, 1952. 3 claims. Assigned to F. N. Burt Co., Inc. [Cl. 221-92.]

Whalley, George F. Pallet. U. S. patent 2,706,099. Filed April 21, 1950. 9 claims. Assigned to Gaylord Container Corp. [Cl. 248-120.] A fiberboard platform, with apertures which permit the stacking of two or more pallets, has hollow cuplike leg members which are attached to the underside of the pallet.

April 19, 1955

Bergstein, Robert M. Reinforced double-walled insert for cartons. U. S. patent 2,706,590. Filed March 2, 1953. 8 claims. [Cl. 229-14.]

Burling, Elmer R., and Rich, John P. Method of bleaching with chlorine dioxide. U. S. patent 2,706,673. Filed October 19, 1951. 1 claim. [Cl. 8-156.] The method claimed permits a complete bleach of wood pulp with chlorine dioxide in a single treatment at acid pH (without the necessity of breaking the treatment into several stages with caustic washing between stages).

Caraher, William F. Shipping cases for rayon. U. S. patent 2,706,593. Filed Feb. 16, 1951. 1 claim. Assigned to E. I. du Pont de Nemours & Co., Inc. [Cl. 229-23.]

Dunning, Robert M. Bottle cases. U. S. patent 2,706,594. Filed Nov. 18, 1950. 3 claims. Assigned to Waldorf Paper Products Co. [Cl. 229-44.] A reinforcing rod is provided in the fold of material directly above the hand hole through the end panel, which allows the case to be lifted by one end, even if the cover is not closed.

Elderkin, Karl O. Water drainage pit for a fourdrinier machine. U. S. patent 2,706,434. Filed Jan. 11, 1951. 6 claims. Assigned to Crossett Lumber Co. [Cl. 92-44.] The recirculation system comprises a wire pit, weir means for maintaining the water at a predetermined level, ducts along the pit side walls with orifices at the water level so that water from the ducts enters the pit and flows laterally to the pit centerline. The weir means include a skimming and make-up water weir and means to induce surface flow in the direction of the skimming weir in order to skim off floating flocculated fibers.

Evers, Arthur J. Web splicing machine. U. S. patent 2,706,515. Filed Sept. 10, 1952. 10 claims. Assigned to International Paper Co. [Cl. 154-42.3.] Means are provided for automatically butt-splicing the head end of a fresh roll of cardboard (used in milk container production) to the tag end of the previously used roll.

Fallert, Clifford D. Locking device for a container. U. S. patent 2,706,595. Filed April 16, 1951. 1 claim. Assigned to Gaylord Container Corp. [Cl. 229-45.] A slotted flap (connected to the body section of the corrugated board container) provides a fold-over tab with a locking ear.

Johansen, Rolf J. Bleaching plant. U. S. patent 2,706,390. Filed Oct. 19, 1953. 6 claims. Assigned to Aktiebolaget Kamyr. [Cl. 68-27.] Means are provided to feed cellulosic pulp of high density from the wash filter to the bottom of the reaction tower and for washing the pulp and mixing new bleaching agents into it during the transfer.

Newberg, Raymond G., Wilson, Howard L., and Sayko, Andrew F. Polyethylene-wax compositions and process for making same. U. S. patent 2,706,719. Filed July 30, 1952. 4 claims. Assigned to Esso Research and Engineering Co. [Cl. 260-28.5.] In the process claimed ethylene is polymerized at above 70°C. and a pressure between 750–30,000 p.s.i. in the presence of a polymerization catalyst; the improvement comprises conducting the polymerization in the presence of molten petroleum wax, thereby producing a polyethylene-wax mixture.

Nigh, Robert R., and Randolph, John W. Duck decoy. U. S. patent 2,706,357. Filed July 7, 1953. 3 claims. [Cl. 43-3.] A ribbed cardboard frame, interlocked for rigidity, has one or more flexible removable plastic cover skins which represent male, female, mallard, or whatever varieties of duck are desired.

Paasche, Bertha. Display head and shoulders. U. S. patent 2,706,588. Filed Aug. 14, 1952. 11 claims. [Cl. 223-84.]

Ringler, William A. Fully partitioned collapsible carrier which is rigid when erected. U. S. patent 2,706,578. Filed May 10, 1949. 6 claims. Assigned to The Gardner Board and Carton Co. [Cl. 220-111.] A rigid distortionless six-celled bottle carrier may be erected from a cut and scored cardboard blank. Longitudinal partition-forming panels are prolonged to provide the handle portions.

Schaller, Maurice. Carton. U. S. patent 2,706,592. Filed June 30, 1950. 3 claims. Assigned to Lorentzen Hardware Mfg. Corp. [Cl. 229-23.] An octagonal two-piece cardboard carton for packing, shipping, and storing coiled metal strip or similar cylindrical objects is claimed.

Sheard, William G. Carton. U. S. patent 2,706,591. Filed May 4, 1950. 8 claims. Assigned to General Container Corp. [Cl. 229-23.] A corrugated board storing and shipping container of high keglike load bearing strength (columnar loads of 1000–5000 lb.) for such heavy articles as nuts and bolts, comprises a plurality of mutually supporting elements which can be folded flat before and after use.

Shobert, Samuel M. Fluid conducting plastic impregnated tubing. U. S. patent 2,706,497. Filed March 24, 1952. 4 claims. [Cl. 138-78.] A light, noncorrosive conduit, useful in or near salt water or under ground, consists of plasticized cardboard tubing in which the raw cardboard serves as the matrix and base material for the plastic.

Snyder, James E. Method of forming a package. U. S. patent 2,706,370. Filed July 20, 1953. 2 claims. Assigned to The Goodyear Tire & Rubber Co. [Cl. 53-5.] A tube of flexible paper stock, cellophane, or the like is formed over a hollow mandrel, filled with the material to be packaged (e.g., viscous liquids, pastes, etc.) and fastened.

April 26, 1955

Atanasoff, John V. Method of forming rodlike paper articles. U. S. patent 2,706,933. Filed Aug. 27, 1951. 8 claims. Assigned to Communications Research, Inc. [Cl. 93-1.] A safe-for-children ice cream sucker stick has a fanfolded paper core covered by a tightly wrapped paper sheet.

Burton, Thomas M. Method of bleaching mechanically disintegrated wood pulp. U. S. patent 2,707,146. Filed Aug. 8, 1951. 11 claims. Assigned to Scott Paper Co. [Cl. 8-104.] Water-soluble hydrosulphite bleaching solution (free of entrained air) is fed into a continuously moving stream of pulp. The pulp solution is then subjected to vigorous agitation in a confined airtight zone. Propulsion means forces the mixture as a continuously moving stream along a confined airtight path comprising a vertical fluid way, until the desired bleaching takes place.

Claff, Clarence L., Claff, Chester E., and Moeller, Carl A. Method and machine for making box blanks. U. S. patent 2,706,944. Filed Jan. 17, 1950. 4 claims. Assigned to M. B. Claff & Sons, Inc. [Cl. 101-227.] Hunting and overcorrecting features are eliminated thereby producing blanks at higher speeds and with more perfect positioning of printed matter on the blanks.

Hertel, Kenneth L. Apparatus for and method of testing porous materials. U. S. patent 2,706,904. Filed April 9, 1951. 12 claims. Assigned to University of Tennessee Research Corp. [Cl. 73-38.]

Hug, Rudolf. Device for fiber-coating materials and objects. U. S. patent 2,706,963. Filed April 12, 1950. 2 claims. [Cl. 118-51.] The process and apparatus claimed, for flock coating small or large surfaces of such materials as paper, wood, cardboard, metal, glass, etc., by means of an electrical field involves the application of an electric field potential to the adhesively coated body to be flocked so that its entire surface acts directly as an electrode surface of the field.

Pasjack, Steve. Cartons and method of making and assembling same. U. S. patent 2,706,935. Filed Jan. 5, 1953. 3 claims. Assigned to Unipak Cartons Ltd. [Cl. 93-37.]

Richardson, Charles D., and Zavist, Algerd F. Treated mica paper insulation. U. S. patent 2,707,204. Filed Oct. 31, 1951. 13 claims. Assigned to General Electric Co. [Cl. 174-110.] The material claimed is impregnated and coated with a mixture comprising (1) an acidic polyester containing free carboxyl groups and the product of a mixture (glycerine and an aliphatic dicarboxylic acid or anhydride containing from 5–10 carbon atoms), and (2) a complex epoxide resin comprising a polyether derivative of a polyhydric organic compound containing epoxy groups.

Shuff, Hugh. Wrap-around chain-driven cutters for removing bark from trees. U. S. patent 2,707, 007. Filed June 8, 1953. 8 claims. [Cl. 144-208.]

Smith, Robert E. Mechanism for releasable locking screen plate in a vat. U. S. patent 2,706,932. Filed June 15, 1954. 3 claims. Assigned to The Sandy Hill Iron & Brass Works. [Cl. 92-30.] The components are so adapted and arranged that the shaft is rotatable between clamping and nonclamping positions. As the shaft rotates for clamping, certain pivotal connectons move past center, so that the clamping of the screen plates and releasing of the platen is readily accomplished.

Sparrow, Donald B., Eberl, James J., and Britt, Kenneth W. Method of bleaching mechanically disintegrated wood pulp. U. S. patent 2,707,144. Filed Aug. 8, 1951. 14 claims. Assigned to Scott Paper Co. [Cl. 8-104.] The bleaching process claimed, of above average brightness, comprises mixing the pulp with a water-soluble hydrosulphate and a water-soluble polyphosphate. (The brightness thus obtained is substantially increased over that brought about when a hydrosulphate is used alone.)

Sparrow, Donald B., Eberl, James J., and Britt, Kenneth W.

Method of bleaching mechanically disintegrated wood pulp. U. S. patent 2,707,145. Filed Sept. 11, 1952. 16 claims. Assigned to Scott Paper Co. [Cl. 8-104.] This is very similar to U. S. patent 2,707,144 (April 26, 1955) (*cf.* abstract above), except that ethylenediamine tetraacetic acid is substituted for the water-soluble polyphosphate in the bleaching process.

Svenson, Eric B. Tear string applying means. U. S. patent 2,706,934. Filed March 30, 1954. 5 claims. Assigned to Joseph Dixon Crucible Co. [Cl. 93-1.] To expose successive lengths of lead, the wound paper (forming the pencil) is slit between successive holes by means of a tear string fed by the apparatus claimed.

Vines, Oscar L. Egg carton. U. S. patent 2,707,073. Filed Aug. 22, 1952. 4 claims. Assigned to Alford Cartons. [Cl. 229-28.]

May 3, 1955

Amberg, Walter E. Paper closure member and paper container. U. S. patent 2,707,588. Filed July 19, 1951. 1 claim. Assigned to Lily-Tulip Cup Corp. [Cl. 229-43.] A spillproof closure member and container (one or two-ounce size) is claimed.

Buttery, Kenneth T. Box or container. U. S. patent 2,707,586. Filed March 3, 1950. 3 claims. Assigned to Sutherland Paper Co. [Cl. 229-16.] A polygonal, windowed box for bakery goods is claimed.

Daneke, Dietrich. Jogging machine. U. S. patent 2,707,632. Filed Aug. 27, 1951. 8 claims. Assigned to Fred M. Brackett. [Cl. 271-89.] A vibratory table has a tilting mechanism which lowers and tilts the table during jogging and then raises and levels the table for movement of the jogged stack of paper sheets onto a feed table.

Jackson, Charles E. Sheet feeding machine. U. S. patent 2,707,568. Filed May 2, 1951. 13 claims. Assigned to Universal Corrugated Box Machinery Corp. [Cl. 214-8.5.] Stacked corrugated board sheets are successively fed by means of the machine claimed which comprises a discharge table pivotally mounted on a suitable support and the operating end of a power unit connected to the table between its pivot support and the loading platform. Motor-driven conveyors are provided to aid the forward movement of the edges of the sheet material against the support.

Larkin, James L. Display stand. U. S. patent 2,707,609. Filed June 22, 1949. 4 claims. Assigned to Forbes Lithograph Manufacturing Co. [Cl. 248-174.]

Meaker, John W. Apparatus for perforating paper and other sheet materials. U. S. patent 2,707,744. Filed Aug. 5, 1953. Issued May 3, 1955. 5 claims. [Cl. 219-19.] An apparatus for producing spaced perforations, slits or slots is claimed.

Rawe, Martin. Bag bottom forming device for paper bag manufacturing machines. U. S. patent 2,707,421. Filed July 21, 1951. 8 claims. [Cl. 93-28.]

Skardal, Karl A., and Börjeson, Olov B. Pulp preparing apparatus. U. S. patent 2,707,420. Filed Feb. 25, 1953. 2 claims. Assigned to Leje & Thurne Aktiebolag. [Cl. 92-26.] The impeller is eccentrically located on the tapering bottom of the tank next to the side wall, and a spiral casing and ascending spiral ramp causes the pulp to be effectively broken up by partially controlled circulation.

Taggart, Donald C. Bed pad. U. S. patent 2,707,289. Filed Feb. 5, 1952. 2 claims. Assigned to The General Cellulose Co., Inc. [Cl. 5-354.]

Wagstaff, Gaston C. Mailing container. U. S. patent 2,707,-589. Filed Oct. 30, 1950. 1 claim. [Cl. 229-92.8.] A mailing envelope has a transparent window affixed so that an advertising device inserted is visible.

Wittstein, Jack A. Packing cartons. U. S. patent 2,707,587. Filed May 7, 1952. 4 claims. [Cl. 229-34.] Two corrugated-board blanks may be assembled into a cushioned shipping container and cover.

Yount, Stanley G. Shipping unit and tensioning means therefor. U. S. patent 2,707,553. Filed Nov. 20, 1951. 5 claims. [Cl. 206-65.] A tensioning tube of paperboard incorporates a Z-folded tensioning zone for holding the shipping unit in place on a corrugated board pallet.

May 10, 1955

Bonaccorsi, James F. Cradle type carton. U. S. patent 2,708,085. Filed Nov. 17, 1952. 5 claims. [Cl. 248-198.] A ventilated shipping or display carton for flowers is claimed.

Caraher, William F. Yarn tube wrapper. U. S. patent 2,708,066. Filed July 26, 1949. 2 claims. Assigned to E. I. du Pont de Nemours & Co., Inc. [Cl. 229-40.] A folder-type, suspending wrapper may be used as a shipping container for wound yarn, lamp chimneys, glasses, etc.

Falkman, Hans H., Karlén, Nial T., and Olsson, Erick M. Bark-cutting machine having yieldable and interconnected supports. U. S. patent 2,707,978. Filed April 10, 1951. 6 claims. Assigned to Aktiebolaget Atlas Diesel. [Cl. 144-208.] A lightweight machine-driven barker is hand movable and has a compressed-air actuated cutting mechanism.

Fries, Karl W., and Becker, Gustav. Laminated paper product. U. S. patent 2,708,177. Filed June 13, 1952. 4 claims. Assigned to Rhinelander Paper Co. [Cl. 154-52.] Glassine plies, laminant, and a network of glass fiber scrim produces a laminated structure of high vapor penetration resistance.

Garrett, Francis A. Paper machine drier drum. U. S. patent 2,707,836. Filed July 1, 1954. 3 claims. Assigned to Canadian International Paper Co. [Cl. 34-124.] Improved steam distribution in drier drums is claimed through the use of a plurality of small diameter, high velocity jets, and siphon tips secured adjacent to the inner face of the drum and connected to a condensate return pipe positioned within the stream-supply header.

Guttman, Joseph M. Mailing cards. U. S. patent 2,708,068. Filed Nov. 12, 1952. 2 claims. [Cl. 229-92.8.] The main body of the card has a serrated detachable identification and/or credit card.

Hesson, Charles W. Wallpaper trimming and pasting machine. U. S. patent 2,707,933. Filed Aug. 5, 1952. 8 claims. [Cl. 118-38.]

Inman, William H. Collapsible carton. U. S. patent 2,708,065. Filed Aug. 25, 1952. 6 claims. Assigned to Bloomer Bros. Co. [Cl. 229-33.] A collapsible cardboard carton and tray for shipping and storing fruits and vegetables may be readily swung to erected position by applying pressure at opposite corners.

Kahn, Lester R. Comb display device. U. S. patent 2,708,029. Filed April 9, 1954. 3 claims. Assigned to E. I. du Pont de Nemours & Co., Inc. [Cl. 206-46.]

Lockman, Carl J. Heat treating a fluid substance. U. S. patent 2,707,991. Filed Dec. 22, 1949. 1 claim. Assigned to Rosenblad Corp. [Cl. 159-20.] A plurality of heat exchangers has a minumum of valves (five three-way valves in the entire system).

Martineau, Stephen E. Paper roll protector. U. S. patent 2,708,031. Filed July 3, 1953. 2 claims. [Cl. 206-59.] A rubber cushion of the same diameter as the end of the up-ended newsprint roll it protects is held in place by a paper wrapping.

Mathewson, Wilfred F. Pulp screen. U. S. patent 2,707,905. Filed April 1, 1953. 13 claims. [Cl. 92-35.] Means are provided to periodically back-wash the various inlet slots by flushing the narrow slot edge by means of water delivered under pressure.

Paton, James B. Heat sealable valve type bag. U. S. patent 2,708,067. Filed Sept. 9, 1954. 3 claims. Assigned to Paton-Chandler Process Co. [Cl. 229-62.5.] A unique feature is the across top and bottom heat sealing of the bags without contamination by the contents (carbon black, etc.) of the areas to be sealed.

May 17, 1955

Allen, Howard G., and Thomas, Charles D. Sheet guiding apparatus for tube forming machines. U. S. patent 2,708,394. Filed Jan. 21, 1950. 2 claims. Assigned to Daystrom, Inc. [Cl. 93-81.] A photoelectric cell-controlled motor actuates the reel (on which roll is mounted) in a lateral direction as to align properly the printing matter on the sheets. A second photoelectric cell actuates a solenoid-operated brake which regulates the intermittent feed of the material.

Buttress, George A. Machine for forming plaster keying depressions in plasterboard. U. S. patent 2,708,300. Filed Aug. 3, 1951. 1 claim. [Cl. 25-44.]

Carpenter, Joseph E. Cationic surface active agents. U. S. patent 2,708,666. Filed Aug. 28, 1953. 9 claims. Assigned to American Cyanamid Co. [Cl. 260-97.5.] Cationic surface-active agents are prepared by adding an epihalohydrin to a mixture of a polyalkylene polyamine and a carboxylic acid selected from the group consisting of rosin acids, hydrogenated rosin acids, and dehydrogenated rosin acids (crude or distilled tall oil).

Ericks, Walter P. Impregnated fibrous board and method of making same. U. S. reissue patent 24,003. Filed June 8, 1954. 19 claims. Assigned to The Upson Co. [Cl. 117-140.] The boards are impregnated with an impregnant having 1–50% of at least one polycarboxylic acid in solution in a volatile hydrophilic solvent (150°C. boiling point) and dried.

Glab, William T. Method of making a molded lignocellulose product. U. S. patent 2,708,637. Filed June 16, 1951. 8 claims. Assigned to Carr, Adams & Collier Co. [Cl. 106-163.] A compact hardboard is made from finely divided Ponderosa Pine (50 mesh and moisture content about 30% by weight), 0.25 to 30% hydrated lime and heated under pressure at about 400–600°F. for about seven to eight minutes. The usual plasticizers or fibrous reinforcing materials may be added.

Klause, Karl. Dispensing package. U. S. patent 2,708,510. Filed Dec. 3, 1952. 15 claims. Assigned to Marathon Corp. [Cl. 206-58.] A conventional waxed paper or foil cutting-dispenser has a heavy score line in the front wall of the container which prevents interference with successive withdrawals of paper.

Norman, Daniel P. Coated paper receptacles. U. S. patent 2,708,544. Filed April 19, 1952. 5 claims. Assigned to Globe Envelopes Ltd. [Cl. 229-3.1.] A paper drinking cup is immersed

in a coating composition which comprises an aqueous dispersion of a urea-formaldehyde resin condensate (540 parts by weight), Styrene copolymer with carboxylic side groups (40 parts), sodium sulphonate of an acid ester of an aliphatic compound (2 parts), and ammonium acid phosphate (30 parts). The coated article is drained for five minutes and then heated to 210°F. for 10 minutes.

Orr, Howard H. Apparatus for incorporating sleeved valves in bags. U. S. patent 2,708,392. Filed July 14, 1952. 12 claims. Assigned to Orr Mfg. Co. [Cl. 93-8.] Mechanisms in the apparatus claimed, in sequence, cut sleeve blanks, shape, and apply paste and open the mouth of the bag to receive the sleeve, and infold the corner of the bag and the sleeve blank to form the valve.

Page, Anthony J., and Haig, David R. P. Flame-resistant fiberboard. U. S. patent 2,708,643. Filed Nov. 1, 1952. 13 claims. Assigned to Johns-Manville Corp. [Cl. 117-69.] 75–95% of a nonswelling clay of the kaolinite or micaceous group, and 5–25% of a swellable clay of fine particle size of the montmorillonite group, 1–1.5% starch, and a clay-dispersing agent provide the coating which serves as an excellent primer for decorative paints.

Pullman, Joseph C., and Ritson, Daniel D. Method of laminating using thermoplastic adhesive surface coating and articles produced thereby, U. S. patent 2,708,650. Filed Oct. 23, 1951. 19 claims. Assigned to American Cyanamid Co. [Cl. 154-140.] The nonblocking laminating adhesive claimed, for use as a bonding agent for a base member (paper) and two or more elements (glass, wood, metal, etc.) is attained by coating the paper with a condensation product of a dicarboxylic acid and either a glycol or a monoalkyl amine. Upon heat-activation the coating exhibits a "tack delay" of 10–20 sec. and may be made to adhere strongly to glass with high compression shear.

Rowlands, Tom. Machine for making corrugated paperboard. U. S. patent 2,708,472. Filed June 17, 1952. 4 claims. Assigned to Molins Machine Co. Ltd. [Cl. 154-31.]

Seith, Theodore L. End-closing, top-opening shipping container. U. S. patent 2,708,545. Filed Jan. 3, 1950. 2 claims. Assigned to Cornell Paperboard Products Co. [Cl. 229-51.]

Ulmschneider, Lawrence A. Method of sealing edges of wrapping material. U. S. patent 2,708,648. Filed Dec. 8, 1951. 4 claims. Assigned to Eastman Kodak Co. [Cl. 154-116.] Plastic facing surfaces of the material are treated so they will fuse.

May 24, 1955

Cox, Glenn H., and Smith, Ted T. Packaging machine for cartons. U. S. patent 2,709,029. Filed Nov. 12, 1952. 12 claims. Assigned 25% to Paul F. Nockels and Everett L. Miller. [Cl. 226-14.] A carrier is slipped over a group of containers and lowered to a carton disposed beneath, at which time the ejecting assembly operates to force the containers into the carton.

Demon, Gerardus A., and Ven, Lodewijk C. van der. Process of manufacturing cellulose powder. U. S. patent 2,709,045. Filed May 9, 1951. 1 claim. Assigned to N. V. Onderzoekingsinstituut Research. [Cl. 241-3.] A dissolving pulp sheet (0.5–3 mm. in thickness and with a moisture content of less than 15%) is passed through a dry-processing zone comprising four pairs of rotating cylindrical rolls maintained at 13°C. The flakes obtained are useful in preparing chemical compounds of cellulose, as a filter medium, paint and varnish additive, etc.

Gondek, Andrew W. Combined shipping and feeding device for baby chicks. U. S. patent 2,709,031. Filed March 12, 1954. 3 claims. [Cl. 229-6.] A corrugated board ventilated container-feeder for 25 chicks is claimed.

Meuly, Walter C., and Tremaine, Breckenridge K. Process for improving the odor of cellulosic pulp by-products. U. S. patent 2,709,133. Filed March 4, 1953. 1 claim. Assigned to Rhodia, Inc. [Cl. 92-9.] 1–100 p.p.m. (based on the sulphate digester charge) of a mixture of at least three odor-bearing organic compounds with three different boiling points are added to the digester charge, (e.g., 0.5 pound each of *n*-butyraldehyde and pyridine, point below 200°C., geranoil and isoborneol 200–250°C., and ionone and benzophenone above 250°C.)

Overbaugh, Charles B. Case for cigarettes and like articles and blank for forming the same. U. S. patent 2,709,033. Filed Jan. 29, 1953. 2 claims. [Cl. 229-16.]

Pearce, Lewis C. Manifold pack making machine. U. S. patent 2,708,760. Filed Jan. 11, 1952. 39 claims. Assigned to Pearce Development Co. [Cl. 11-1.] The device receives spread sheets from a collating machine, applies adhesive to exposed portions of the sheets, accumulates and registers the sheets, and then slits a stack of sheets to form several portions.

Perilli, Louis. Box blank setting up machine. U. S. patent 2,708,862. Filed Jan. 11, 1951. 6 claims. [Cl. 93-49.] Expensive prefolding of the blanks is avoided by operation of this device.

Ritchie, Manfield F. Containers. U. S. patent 2,709,032. Filed June 13, 1950. 2 claims. Assigned to Twin Cities Container Corp. [Cl. 229-16.] Corrugated board packing and shipping container for fruits and vegetables.

Welsh, Ormonde P. Envelope blank feeding mechanism U. S. patent 2,709,081. Filed Dec. 29, 1950. 13 claims. Assigned to Parten Machinery Co. [Cl. 271-2.]

May 31, 1955

Bergstein, Robert M. Paperboard bottle carrier having full depth transverse partitions. U. S. patent 2,709,535. Filed Nov. 1, 1952. 6 claims. Assigned to The Bergstein Packaging Trust. [Cl. 220-113.]

Bridge, Adam E. Paper machinery. U. S. patent 2,709,396. Filed April 21, 1953. 12 claims. Assigned to The Black-Clawson Co. [Cl. 92-27.] A plug for a Jordan refiner in which the individual bars are firmly locked against axial and radial movement.

Bugg, Kenly C. Tube winding machines. U. S. patent 2,709,400. Filed Oct. 22, 1952. 2 claims. Assigned to Paramount Paper Tube Corp. [Cl. 93-80.] Multilayer rectangular tubes of substantial size range and wall thickness are wound and cut off to desired lengths.

Gilbert, Jack H. Cigarette package. U. S. patent 2,709,548. Filed June 9, 1953. 1 claim. [Cl. 229-51.] Withdrawal of cigarettes is effected by slits and weakened portions which form a tear-off portion in the outer-foil wrapper, a tear-back portion with flap in the inner paper wrapper, and a fold-back portion with flap in the inner wrapper.

Hansel, Sydney. Oscillatable bark-removing elongated jets providing continuously parallel lines of impingement. U. S. patent 2,709,465. Filed April 12, 1954. 3 claims. [Cl. 144-208.]

Haslacher, Alfred B. Laminated bag bottom. U. S. patent 2,709,549. Filed March 22, 1952. 1 claim. [Cl. 229-55.] A satchel-bottom moisture and siftproof bag can be made from a flattened paper and thermoplastic laminated tube on existing bag-making machinery.

Niedringhaus, Marion W. Containers. U. S. patent 2,709,547. Filed Jan. 26, 1953. 2 claims. [Cl. 229-23.] A portable furniture storage repository comprises a pallet-type wooden base, a pair of paperboard side-forming panels, and a paper baglike cover.

Perry, Lorenzo D. Hand operated tool for application of heat seal label to package or container. U. S. patent 2,709,742. Filed Oct. 31, 1952. 3 claims. [Cl. 219-21.]

Schwaderer, George J., Jr., and Tucker, James E. Burial wrapper. U. S. patent 2,709,293. Filed Feb 26, 1953. 11 claims. [Cl. 27-21.] A composite wrapper has an inner rectangular 10–20-ply layer matted to 3/8-in. thickness so spot laminated that the plies may be separated when applied to the remains. A polyvinyl chloride film comprises the moisture-resistant outer film.

Wolf, Michael J., Cannon, John A., and MacMasters, Majel M. Extracting hemicelluloses. U. S. patent 2,709,699. Filed July 18, 1952. 4 claims. Assigned to United Sates of America as represented by the Secretary of Agriculture. [Cl. 260-209.] Corn hulls are heated to 90–115°C. in an aqueous alkaline medium (sodium carbonate or sodium hydroxide) at a pH within 9–13 for about one hour. The supernatant liquor is acidified with hydrochloric acid to pH 4 and three volumes of ethanol are added to precipitate the hemicelluloses. The precipitate is then separated by filtration and dried in a vacuum desiccator.

June 7, 1955

Bertorelli, Orlando L. Treatment of kaolin. U. S. patent 2,710,244. Filed Feb. 17, 1951. 4 claims. Assigned to J. M. Huber Corp. [Cl. 23-110.] To purify raw kaolin it is dried and ground and mixed and reacted with 0.05–0.1% by weight of ammonia (ammonia gas or aqueous ammonium hydroxide).

Birkmann, Louis F. Tape slitter with spring-pressed knives. U. S. patent 2,710,060. Filed May 20, 1952. 5 claims. [Cl. 164-36.] A storage roll of tape is rotatably mounted on an axis fixed relative to the blade-carrying frame, and a spring resiliently urges the blade into cutting engagement with the outer layer of the tape on the roll.

Bishop, Thomas D. Apparatus for slotting or cutting cardboard and the like for the manufacture of boxes. U. S. patent 2,710,061. Filed Nov. 25, 1953. 8 claims. Assigned to The Diretend Engineering Co. Ltd. [Cl. 164-60.] This is an improvement on U. S. patent 2,701,613 (Feb. 8, 1955), and provides means whereby three or more cutting units (each comprising pairs of male and female knives) may be used and independently adjusted laterally relative to one another.

Bruker, Hobart W. Corrugated paper web guiding and tensioning apparatus. U. S. patent 2,710,045. Filed Feb. 6, 1953. 5 claims. Assigned to George W. Swift, Jr., Inc. [Cl. 154-32.] This web-tensioning mechanism is so constructed that it may be lowered to floor level for threading of a new web.

Bruker, Hobart W. Single-facing machine. U. S. patent 2,710,044. Filed May 27, 1954. 8 claims. Assigned to George W. Swift, Jr., Inc. [Cl. 154-31.] A single-facing machine with matting corrugated rolls has a novel carriage-mounted, pressure-roll assembly, installed upon guides which afford wide-range

movement of the pressure roll (1.5–2 ft.) away from the second corrugating roll.

Bump, Charles K. Process of bonding asbestos fibers with a titanium polymer and article produced thereby. U. S. patent 2,710,268. Filed Oct. 6, 1950. 10 claims. Assigned to Monsanto Chemical Co. [Cl. 117-126.] A method is provided for increasing the wet strength and tear resistance of fabricated asbestos fibers in the form of paper, rope, batts, cloth, etc., for use as insulation.

Clark, Bryce L., and Miller, Carl S. Heat-sensitive copying-paper. U. S. patent 2,710,263. Filed Feb. 2, 1951. 10 claims. Assigned to Minnesota Mining & Manufacturing Co. [Cl. 117-36.] A coated copy-paper when placed in heat conductive contact with a typewritten message and on irradiation of the message with high-intensity illumination provides a reproduction of the message without splitting or offsetting.

Foster, William J., and Gretzinger, John R. Bellows folding machine. U. S. patent 2,709,950. Filed Nov. 4, 1948. 20 claims. Assigned to General Motors Corp. [Cl. 93-1.] The prismatic-bellows device is provided with a plurality of folding blades mounted on lazy tongs which move inwardly and toward the fixed end of the machine to form alternately a pair of horizontal and a pair of vertical pleats in a paper tube.

Gaylord, Clifford W. Container end wall handhole reinforcement. U. S. patent 2,710,135. Filed July 19, 1950. 4 claims. Assigned to Gaylord Container Corp. [Cl. 229-52.]

Geller, Joseph J. Partition means for display cartons. U. S. patent 2,710,131. Filed June 26, 1953. 3 claims. [Cl. 229-15.] An economical cell-forming tray structure may be formed from a cardboard blank, cut, and scored without any waste of material.

Grecco, Louis P. Multiple divisible carton for bottled beverages and the like. U. S. patent 2,710,130. Filed Feb. 12, 1952. 8 claims. [Cl. 229-15.]

Hubmeier, Max. Apparatus for corrugating paper or cardboard. U. S. patent 2,710,043. Filed April 14, 1952. 6 claims. Assigned to Aktiengesellschaft der Maschinenfabrik von Theodor Bell & Cie. [Cl. 154-30.] Means are provided for producing longitudinally, corrugated paper or board, and crosswise corrugated board (double-double board) in a continuous process at high speeds of operation.

Knoll, William V. Machines for treating papermaking material. U. S. patent 2,709,949. Filed Dec. 16, 1952. 4 claims. [Cl. 92-22.] A beater-roll mechanism rotatably mounted in a beater tub with several bed plates on antifriction bearings, consists of equally spaced helical vanes which act to guide the pulp around the beater rolls.

Lichtenstein, Immanuel. Paper impregnated with ammonium alum and process of impregnating. U. S. patent 2,710,264. Filed May 16, 1952. 15 claims. Assigned to Structural Paper Co. [Cl. 117-92.] The process comprises impregnating the felted cellulosic materials for brief periods in a bath of ammonium alum and water, maintained at a specific gravity of 1.452–1.485 and at 104–109°C.

Lichtenstein, Immanuel. Paper impregnated with potassium alum and process of impregnating. U. S. patent 2,710,265. Filed May 16, 1952. 13 claims. Assigned to Structural Paper Co. [Cl. 117-92.] The same as above except that the bath comprises potassium alum and water with a specific gravity of 1.440–1.535. The temperature range is 102–104°C.

Metzger, Henry L. Cover or container member for a semi-circular telescopic box. U. S. patent 2,710,132. Filed Dec. 29, 1949. 3 claims. [Cl. 229-18.]

Mottet, Arthur L., Heppenstall, Thomas E., and Kletsch, Wayne R. Veneered consolidated products and method of making same. U. S. patent 2,710,276. Filed March 13, 1951. 14 claims. Assigned to The Long-Bell Lumber Co. [Cl. 154-118.] A process is given for making veneered hardboard from a compressible felt of wood particles in the form of fibers, flakes, or shavings and covered with scrap pieces of veneer.

Rau, Eric J. Flatware tray and cover. U. S. patent 2,710,094. Filed Nov. 18, 1952. 9 claims. Assigned to Container Corp. of America. [Cl. 206-45.15.] Three cut and scored cardboard blanks may be folded and articulated to form a combination tray, tray insert (or article holder) and cover for displaying and transporting flatware.

Repking, Edward F., and Wasyluka, Paul. Shipping container. U. S. patent 2,710,133. Filed March 30, 1951. 1 claim. Assigned to Gaylord Container Corp. [Cl. 229-27.] A ventilated solid or corrugated fiberboard receptacle for live chicks is claimed; it comprises a one-piece body section with integral diagonal partitions and a one-piece lid of overlapping skirt-type construction which separates the side and end walls from adjacent containers.

Robins, Seymour. Mailing piece. U. S. patent 2,710,095. Filed April 20, 1950. 2 claims. [Cl. 206-46.] A Christmas greeting card includes a simple paper envolope and flat enclosure which is so designed that it will expand into a three-dimensional Christmas tree ornament.

Schroeder, Louis H., and Wagner, Joshua. Corrugated paperboard box structure. U. S. patent 2,710,134. Filed Jan. 18, 1954. 2 claims. Assigned to Dixie Container Corp. [Cl. 229-37.] A strong reinforced box is made from a corrugated-board box blank constructed in such an arrangement that the side walls of the box are of multiwalled board having more plies than the main areas of the blank which constitute the end flaps of the box.

Skow, Ross E. Applicator for applying pressure-sealing material in a rotary envelope making machine. U. S. patent 2,709,951. Filed Sept. 22, 1952. 10 claims. Assigned to Berkley Machine Co. [Cl. 93-62.] A rotary segmental applicator is especially adapted to apply pressure-sealing materials (e.g., latex) so that pressure-sealing envelopes are delivered from the rotary-type envelope machine in completed condition at the same high production rate as conventional envelopes.

Trusler, Ralph B. Paper coating compostion containing an optical brightener. U. S. patent 2,710,285. Filed Aug. 11, 1951. 2 claims. Assigned to The Davies-Young Soap Co. [Cl. 252-301.2.] A paper coating composition containing an optical brightening agent consists of carnauba wax (100 parts), oleic acid (15 parts), isopropanolamine (6 parts), water (900 parts), and α-benzyl-β-methylumbelliferone (1 part).

Van Blaricom, Lloyd E., and Gray, Kenneth R. Lignosulphonate recovery from waste sulphite liquor. U. S. patent 2,710,255. Filed June 7, 1952. 16 claims. Assigned to Rayonier, Inc. [Cl. 92-2.] The principles of lignosulphonate recovery from spent sulphite liquor, as described in the following patent, is applied specifically to ammonia-base spent sulphite liquor with added provision for ammonia recovery for re-use in the ammonia-base cooking process.

Van Blaricom, Lloyd E., and Gray, Kenneth R. Processing chemicals. U. S. patent 2,710,254. Filed April 27, 1951. 15 claims. Assigned to Rayonier, Inc. [Cl. 92-2.] Low molecular-weight lignosulphonates are recovered from spent sulphite liquor by adsorption on tertiary-type, anionic-exchange resins.

June 14, 1955

Ahlmeyer, Heinz, and Sherman, Whitney D. Machine for setting up folding cartons of paperboard and the like. U. S. patent 2,710,566. Filed Dec. 7, 1949. 4 claims. Assigned to Robert Gair Co., Inc. [Cl. 93-49.]

Alexander, Ronald R. Wood chipper. U. S. patent 2,710,635. Filed Feb. 20, 1953. 4 claims. Assigned to Improved Machinery, Inc. [Cl. 144-162.] A self-feeding, drum-type wood chipper produces chips of uniform fiber length from heavy, large-diameter logs at a uniform rate by means of a feed control located on the drum between the knives.

Carpenter, Joseph E. Condensates of tall oil with polyalkylene polyamines containing hydroxy ethyl groups. U. S. patent 2,710,856. Filed Dec. 22, 1951. 8 claims. Assigned to American Cyanamid Co. [Cl. 260-97.5.] Cationic surface-active agents are prepared by reacting tall oil at 120–300°C. with hydroxyalkyl-substituted polyalkylene polyamines of the present invention; a substantially complete reaction of the rosin as well as the fatty acids of the tall oil takes place.

Charles, Frank R., and Dixon, Julian A. Treatment of cellulose with the reaction product or primary aliphatic amines and ethylene oxide. U. S. patent 2,710,861. Filed Aug. 20, 1951. 4 claims. Assigned to Canadian International Paper Co. [Cl. 260-212.] The incorporation of small amounts of condensation products (0.1–0.2% on the weight of the pulp) of ethylene oxide and the primary amines from animal fats (Armeen T or Armeen TD) in aqueous solution subsequent to the formation of pulp sheets but prior to regeneration is claimed to result in a superior pulp for conversion to viscose.

Deutschmeister, Herman, and Deutschmeister, Abraham. Two-way mailing device. U. S. patent 2,710,716. Filed Jan. 10, 1950. 2 claims. [Cl. 229-73.] A gummed and cut paper blank defined by perforated lines provides a two-way mailing folder adapted to carry merchandise together with a filable card for the addressee.

Evans, John G., Leach, James H., and Meals, William S. Process for improving retention of fillers in fibrous material. U. S. patent 2,710,816. Filed March 13, 1951. 11 claims. [Cl. 117-121.] Filler retention is improved by reacting the hydroxyl, carboxyl, and/or amino reactive groups in the fibrous material with an isocyanate-bisulphite reaction product.

Fergnani, Walter P. Box blank feeding magazine. U. S. patent 2,710,752. Filed Sept. 12, 1951. 3 claims. Assigned to Post Machinery Co. [Cl. 271-35.] The invention relates to a machine for feeding flat box blanks from a stack to and along a predetermined path. The device primarily concerns a magazine for holding the stack of blanks, which is adjustable to handle blanks of different widths.

Gamble, Hedwig. Machine for making windowed envelopes. U. S. patent 2,710,702. Filed Oct 8, 1951. 4 claims. [Cl. 216-25.]

Luther, Glenn C. Machine for making file folders, filing guides, etc. U. S. patent 2,710,567. Filed May 14, 1951. 2 claims. Assigned to The Olm Co. [Cl. 93-93.]

Messing, Hjalmar S. Pressure controlling device for pulp producing apparatus and the like. U. S. patent 2,710,726. Filed

Aug. 16, 1951. 6 claims. Assigned to American Defibrator Inc. [Cl. 241-256.] Improved means provided for setting the position of the movable disk relative to the fixed disk in an Asplund Defibrator comprise a lever pivotally mounted between its ends to one end of the shaft. The shaft exerts a push on a pivot in causing the toggle links provided to open or spread out, and thus permitting manual removal of any foreign object entering between the grinding disks.

Peters, Ralph W., and Mengel, Joseph W. Black dyed interleaving paper. U. S. patent 2,710,800. Filed Oct. 1, 1952. 5 claims. Assigned to Eastman Kodak Co. [Cl. 92-3.] A photographically inert, nonsmudging, nonlight-transmitting, nonpressure desensitizing black paper is claimed.

Prossen, Louis F. Yarn package. U. S. patent 2,710,689. Filed Aug. 18, 1950. 12 claims. Assigned to Celanese Corp. of America. [Cl. 206-65.] A corrugated-board carton includes inserts of the same material for supporting layers of yarn packages.

Whitehead, Earl B. Display and shipping device for annular object or the like. U. S. patent 2,710,687. Filed July 16, 1953. 3 claims. Assigned to Atlantic Carton Corp. [Cl. 206-45.26.] An object such as a coil of fish line may be positioned between the front and inner side walls of a slotted and strutted cardboard shipping device. For display purposes the strut and easel superposed on the back wall may be pulled out into locked position.

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Argodale, John. Containers. U. S. patent 2,711,281. Filed July 16, 1952. 1 claim. Assigned to Twin Cities Mfg. Co. [Cl. 229-37.] A container for heavy produce is erected from a cut and scored corrugated-board blank and the separate cover from a cardboard blank with locking tongues which engage the slots provided in the container-body blank.

Bauling, Adrianus L. Apparatus for coating paperboard. U. S. patent 2,711,156. Filed May 17, 1952. 5 claims. Assigned to American Viscose Corp. [Cl. 118-60.] Straw paperboard is coated on one side with a cellulose ether, sprayed with dilute 10% H_2SO_4 solution which coagulates the cellulose ether, sprayed with 5% $NaHCO_3$ solution to neutralize the acid and dried to a moisture content of 2–6%. The final product is greaseproof and nonabsorbent.

Birdseye, Clarence. Progressive explosion process of defibration. U. S. patent 2,711,369. Filed March 17, 1951. 8 claims. Assigned to Process Evaluation and Development Corp. [Cl. 92-1.] A process for the defibration of wood chips, etc., consists of digestion while advancing the charge successively to a series of decompression stations whereby the vapor pressure is reduced to atmospheric pressure.

Brooks, Donald H. Display packaging. U. S. patent 2,711,-246. Filed April 13, 1953. 6 claims. [Cl. 206-80.] Paper or thin cardboard sheet display packaging printed with instructions for use of pharmaceutical tubes are bent inwardly at opposite edges to form upstanding triangular units held in place on a strip by strappings of transparent adhesive tape, and the entrie assembly then packaged in a cardboard retaining tube.

D'Esposito, Julian. Container with locking cover. U. S. patent 2,711,282. Filed Dec. 14, 1951. 2 claims. Assigned to Container Corp. of America. [Cl. 229-45.] A cardboard container may be assembled from two cut and scored blanks representing the tray and cover members, so that the telescoping cover with integral flaps is automatically locked in place.

Hagglund, Erik K. M., and Enkvist, Terje U. E. Method of improving the yield of methyl sulphide obtained by heating waste liquors from cellulose manufacture by adding inorganic sulphides. U. S. patent 2,711,430. Filed April 27, 1951. 7 claims. Assigned to Svenska Cellulosaforeningens Centrallaboratorium (Cellulosaindustriens Centrallaboratorium). [Cl. 260-609.] A method of producing methyl sulphide is claimed, in which sulphate black liquor is heated in the presence of a substance containing inorganic sulphidic or hydrosulphidic sulphur at 150–500°C. Methyl mercaptan formed in the heat treatment is converted to additional methyl sulphide by well-known procedures.

Johansen, Rolf J. Bleaching plant and method of bleaching cellulose pulp. U. S. patent 2,711,359. Filed Oct. 19, 1953. 5 claims. Assigned to Aktiebolaget Kamyr. [Cl. 8-156.] A process is given for bleaching cellulosic pulp wherein the bleached pulp is diluted with wash liquor at the top of the tower, dropping it into a vertical drop tube and discharging the air-entrained pulp from the lower end of the drop tube into a device for separating liquid and air. The pulp is then sent through a pressure filter.

MacLaurin, James D. Method and apparatus for watermarking paper. U. S. patent 2,711,120. Filed Sept. 6, 1947. 5 claims. [Cl. 92-38.] The device in the form of a flexible metal belt with openings in the shape of the watermark constitutes a traveling stencil which is positioned over the wire of the paper machine. As the stencil openings are advanced under an airbox (with discharge nozzles), the belt is pressed by air pressure in the box against the paper web.

Lurie, David. Manufacture of sized, filled paper. U. S. patent 2,711,370. Filed April 12, 1954. 4 claims. Assigned to American Cyanamid Co. [Cl. 92-21.] A method is claimed for manufacturing sized paper of improved opacity, wet strength, and weight while discharging a white water with a dissolved sulphate ion content not materially greater than that of the make-up water.

Novotny, Edison H. Method and apparatus for fiber collection. U. S. patent 2,711,381. Filed Sept. 24, 1949. 13 claims. Assigned to Johns-Manville Corp. [Cl. 154-101.] A method and apparatus for collecting opened fibers in a uniform lightweight felt comprises delivering the fibers in an airstream to a collection chamber at a point above a collection zone thereof, introducing a finely divided binding material to said fibers, subjecting the fibers and binder to a fiber opening and binder-distributing operation, and discharging the opened fibers with binder into an air current moving toward the collection zone to form a suspension therein. The fibers are collected as a felt on a conveyor and converted into a blanket by a lapping operation.

Ohlson, Paul E., and Hodge, Edward A. Jacketed steam drier. U. S. re-issue patent 24,024. Filed Feb. 7, 1955. 15 claims. Assigned to The Pusey & Jones Corp. [Cl. 34-124.] One or more flow-resistant rings are positioned between the existing gastight end rings sealing the cylinder walls, which results in more uniform circumferential flow of steam.

Pintell, Milton H. Foil laminate. U. S. patent 2,711,380. Filed Nov. 7, 1952. 3 claims. Assigned to Reynolds Metals Co. [Cl. 154-45.9.] A laminate is prepared from metal foil, a partially cured phenolic resin saturated paper layer, a thermosetting adhesive comprising acrylonitrile butadiene copolymer, and a phenolic resin in more advanced stage of condensation and disposed between said foil and paper layer.

Richardson, Edward M. Reinforced fiberboard box. U. S. patent 2,711,280. Filed July 17, 1950. 1 claim. Assigned to Edward P. Schoenthaler. [Cl. 229-23.] A strong inexpensive fiberboard box is assembled from a cut and scored blank or blanks in such a manner that woodstrip-reinforcing members are disposed along the side walls next to the cover or top flaps to resist forces tending to crush the box.

Sandberg, Robert W. Pressure sensitive manifold sheet. U. S. patent 2,711,375. Filed Feb. 19, 1954. 2 claims. Assigned to The National Cash Register Co. [Cl. 117-36.] The sheet is provided with a transfer coating of pressure-rupturable microscopic capsules of oily printing fluid (crystal violet lactone) protected from escape by a film-forming complex of gelled hydrophilic gum arabic and gelatin.

Shields, Albert F. Corrugator guide member. U. S. patent 2,711,206. Filed Dec. 31, 1952. 7 claims. Assigned to S. & S. Corrugated Paper Machinery Co., Inc. [Cl. 154-31.] A machine for making single-faced corrugated paper includes guide mechanisms in the form of pairs of offset guide fingers for the corrugating adhesive applying and liner applying rollers.

Snider, Stanley, R., and Snider, Walter L. Advertising device. U. S. patent 2,711,038. Filed Aug. 11, 1952. 5 claims. [Cl. 40-126.] A simulated loaf of bread, meat loaf, baked Alaska, or the like is produced by articulating the cardboard base and partition members and covering the dummy with a realistically decorated vinyl plastic skin.

Southam, Earl A., Davis, Howell, F., and Wennes, George P., Jr. Tool for applying edge reinforcement to papermaking woven wire belt. U. S. patent 2,771,469. Filed Feb. 25, 1952. 2 claims. Assigned to The Lindsay Wire Weaving Co. [Cl. 219-21.] A hand-operated tool with electric heating element repairs fourdrinier-wire edge defects by applying heat and pressure to fuse polyethylene reinforcement sheets disposed on either side of the wire.

Wachter, Aaron, and Skei, Thurston. Vapor-phase corrosion inhibition with a mixture of inhibitors. U. S. patent 2,711,360. Filed Oct. 21, 1950. 13 claims. Assigned to Shell Development Co. [Cl. 21-2.5.] Wrapping material (kraft paper or board, cloth, metal foil, or plastic films) are coated or impregnated with a mixture of an organic-base nitrate salt (such as dicyclohexyl ammonium nitrate) and a weak organic acid salt of an amine (dicyclohexyl ammonium fumarate) in a weight ratio of about 5:1 or 20:0.3.

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Batkin, Stanley I. Carrier for milk containers. U. S. patent 2,711,922. Filed March 29, 1952. 21 claims. [Cl. 294-87.2.]

Brown, Howard M. Machine for the manufacture of felted sheet material. U. S. patent 2,711,675. Filed Dec. 21, 1951. 1 claim. [Cl. 92-38.] The formation unit claimed permits the formation of a heavy felted sheet of asbestos cement, asphalt shingle board, etc., at a single pass of the felting apron past the slurry reservoir.

Bruner, Walter M. Making paper using a modified urea-formaldehyde resin. U. S. patent 2,711,961. Filed April 7, 1950. 7 claims. Assigned to E. I. du Pont de Nemours & Co., Inc., [Cl. 92-21.] Improved wet strength in paper results from the use of urea-formaldehyde modified by the addition of hexamethylenediamine, while controlling the pH so that it does not fall below 3.

The condensation product in the sheet is polymerized in the presence of a catalyst.

Buttery, Kenneth T., and Vander Lugt, Thomas, Jr. Collapsible partitioned carton. U. S. patent 2,711,844. Filed Nov. 13, 1951. 8 claims. Assigned to Sutherland Paper Co. [Cl. 220-111.] A rigid, six-celled, handled bottle carrier may be formed from an integrally cut and scored cardboard blank. It may be quickly erected from collapsed form merely by pressing on opposite end edges.

de Cordero, Catalina R. Disposable waterproof paper raincoat. U. S. patent 2,711,538. Filed Aug. 12, 1953. 5 claims. [Cl. 2-84.] A seamed, single-use waterproof raincoat of waxed paper, adjustable to small, medium, and large sizes, has a hood portion and arm holes and may be folded into a sufficiently small unit to be dispensed from coin-vending machines.

Grettve, Karl E. L. Expansible mandrel. U. S. patent 2,711,-863. Filed Dec. 27, 1951. 14 claims. Assigned to Lilla Edets Pappersbruks AB. [Cl. 242-72.] Pneumatic means are provided for expanding and deflating a rubber hose in contact with the inner diameter of the core of a paper roll.

Heygel, Paul R., and Kaltenbach, Ernest G. Core shaft supporting means for slitting machines. U. S. patent 2,711,861. Filed Dec. 22, 1949. 8 claims. Assigned to Ecusta Paper Corp. [Cl. 242-65.] This is a device for supporting, aligning, and facilitating the removal of the bobbin core shafts of a machine which slits a paper web and rewinds the slit sections onto bobbins for use in a cigarette making machine.

Hollmann, Julius Z. Process for making insulating siding. U. S. patent 2,711,970. Filed July 26, 1952. 4 claims. Assigned to the Patent and Licensing Corp. [Cl. 117-5.] Insulating siding is made by cutting a rectangular groove in the center of one face of a board blank, applying bitumen and granules thereto and the blanks split in the middle of the groove to form shiplaps on the resulting two pieces of insulating siding.

Novak, Izador J. Purification of fibrous asbestos. U. S. patent 2,711,822. Filed July 24, 1953. 6 claims. Assigned to Raybestos-Manhattan, Inc. [Cl. 209-166.] A novel froth-flotation method of refining milled chrysotile asbestos fibers comprises aerating a dilute aqueous slurry in the presence of dioctyl sodium sulphosuccinate (Aerosol O.T.) in the mixing zone.

Petter, Noel A. Collapsible cellular carton. U. S. patent 2,711,852. Filed Aug. 17, 1953. 1 claim. Assigned to Standard Paper Box Corp. [Cl. 229-28.] A collapsible multiple cell package with display windows covered with transparent sheeting for displaying figs, apples, citrus fruit, etc., contains a single row cell and may be made from a simple cut and scored rectangular cardboard blank.

Poppe, George W. Paper bag with mouth closure lock. U. S. patent 2,711,853. Filed April 29, 1952. 2 claims. Assigned to Equitable Paper Bag Co., Inc. [Cl. 229-68.] A paper bag of this type can be made in the usual bag machine since the mouth-closure locking tongues may be severed to define tongues which interregister when the flap is folded by an appropriate rotary die cutter incorporated in the machine.

Rabby, Joseph G. Two-piece container for carrying heavy loads. U. S. patent 2,711,851. Filed Oct. 11, 1952. 6 claims. Assigned to National Container Corp. [Cl. 229-23.] A simply constructed hexagonal lightweight inexpensive container for carrying heavy loads may be easily erected from two preassembled blanks. One blank of corrugated fiberboard is foldable to define the side walls, whereas the other defines the bottom walls but also includes solid-fiberboard side walls adapted to be secured to the lower ends of the body side walls.

Richardson, Ralph R., Homan, William H., and Ritter, Walter T. Waste removing equipment for box blanking apparatus. U. S. patent 2,711,676. Filed Sept. 29, 1949. 9 claims. Assigned to Chicago Carton Co. [Cl. 93-36.] The invention claimed comprises a waste picker for the automatic removal of the waste sections of blanks on existing conventional box-blanking machines.

Stenger, Richard C. Method of erecting double-walled boxes. U. S. patent 2,711,677. Filed April 19, 1952. 3 claims. Assigned to Sutherland Paper Co. [Cl. 93-49.] A method for erecting a collapsed double-walled cardboard box either mechanically or manually is claimed, which results in an effective interlocking of the parts when the structure is in completely erected position.

Straka, Cyril J. Method of making rolled phenolic resin-bonded paper tubing. U. S. patent 2,711,982. Filed Feb. 21, 1951. 2 claims. Assigned to Westinghouse Electric Corp. [Cl. 154-83.] The process for producing a rolled tubing of a density above 1.3 and low moisture absorption without use of external pressure involves impregnating the paper with a mixture of two phenolic resin varnishes, and the application of heat.

Vander Lugt, Thomas, Jr. Compartment carton. U. S. patent 2,711,819. Filed Aug. 15, 1951. 8 claims. Assigned to Sutherland Paper Co. [Cl. 206-45.14.]

Van Rosen, Robert E., Arens, George F., and Struble, Glenn E. Carrier for articles of merchandise. U. S. patent 2,711,843. Filed Jan. 11, 1952. 1 claim. Assinged to The Gardner Board & Carton Co. [Cl. 220-110.] A collapsible, sling-type carrier for breakable articles such as glassware is made from a cardboard blank cut and scored to form a six-celled carrier whose handle structure extends to and is "fastened" to the center part of the bottom panel.

Wellmar, Sven. Method for dehydrating and drying of weblike material. U. S. patent 2,771,591. Filed May 24, 1951. 5 claims. Assigned to AB Svenska Flaktfabriken [Cl. 34-18.]

Young, Lewis D. Bracelet holder display box. U. S. patent 2,711,820. Filed April 26, 1952. 2 claims. Assigned to Douglas Young, Inc. [Cl. 206-45.19.]

Zesbaugh, Lawrence G. Method for covering cylinders with foraminous materials. U. S. patent 2,771,575. Filed June 15, 1951. 4 claims. Assigned to Minnesota and Ontario Paper Co. [Cl. 29-148.4.] A wire screen is secured under tension (attached at intervals by wire fastenings) on a forming roll used for making fiberboard so that the tension is uniform for the full circumference of the forming cylinder.

LETTER TO THE EDITOR

Mechanical Pulping Conference

To the Editor, *Tappi:*

Of all meetings I have attended in the past years, I would say that the International Mechanical Pulp Conference in Poland Spring is one of the most interesting. To this has contributed not only the actual proceedings but also the friendly atmosphere created when pulp and paper people spend a few days together in such a charming place as this. I have met many old friends and hope to have made numerous new ones and this indeed is the highlight of my sojourn to your great country.

In the past, interest has concentrated more on chemical pulping and paper manufacture and less on groundwood. This conference has proved that the groundwood field is inexhaustible as far as operating and research problems are concerned and I am convinced that our meeting has been a stimulating injection to stir us all to new efforts. I credit the organizers of the meeting for having made it so successful.

Otto Brauns
Swedish Wood Research Institute, Stockholm, Sweden

RECENT BOOKS

Chemical Engineering Materials. By Frank Mumford, New York Chemical Publishing Co., 1955. Cloth, $5^1/_2 \times 9$, 382 pages. $7.50.

This book, originally published in England, deals with construction materials used in the process industries. Emphasis is placed upon the general mechanism of chemical attack and the essential methods of materials testing.

Special consideration is given to the corrosion resistant nature of iron, ferrous alloys, lead, aluminum, magnesium, nickel alloys, silicon iron, cements, stoneware, bricks, wood, plastics, rubber, and protective coatings.

Encyclopedia of Chemical Technology. Vol. 14. Edited by Raymond E. Kirk and Donald F. Othmer, Polytechnic Institute of Brooklyn, New York, 1955. Interscience Publishers, Inc. Cloth, $7^1/_2 \times 10^1/_2$, 980 pages. $30.

The 15 volumes of the Kirk-Othmer encyclopedia are

approaching completion. Volume 15, the final text will be ready for distribution in February, 1956, and will contain the index to the entire set of 15 volumes. Until March, 1956, each volume in the series can be purchased at $25 if all volumes are purchased. No research laboratory should be without the Encyclopedia, presenting as it does a comprehensive summary of industrial knowledge on materials, methods, processes, and equipment on every technical subject from Abrasives to Zirconium. Messrs. Kirk and Othmer and their associates have done a monumental job and performed a real needed service to industry and science.

The preceding volumes have been reviewed in *Tappi*. Following are some of the subjects covered in Volume 14: Thermodynamics, Thio-compounds, Tin, Titanium, Trade-Marks, Turbidity, Turpentine, Type Metals, Ultrasonics, Units and Their Symbols, Urea, Vacuum Technique, Volume, Vanillin, Vapor-Liquid Equilibria, Varnish, Vat Dyes, Vinyl Compounds, Viscometry, Wallboard, Industrial Wastes, Water and Waterproofing.

Determination of Organic Structures by Physical Methods. Edited by E. A. Braude and F. C. Nachod. Academic Press, Inc., New York, 1955. Cloth, 6 × 9, 810 pages. $15.

A number of authors have collaborated to provide a critical evaluation of the operational rather than the methodological concept of the subject. They deal with the more important physical methods of determining the structure of organic compounds from the functional point of view.

Part I features the determination of molecular size giving consideration to melting and boiling points, molar volume, parachor, osmotic pressure, diffusion, viscosity, and sedimentation equilibrium and velocity.

Part II concerns itself with the molecular pattern as measured by optical rotation, ultraviolet and infrared absorption, Raman-spectra, and magnetic susceptibilities.

Part III deals with the determination of molecular fine structure as indicated by surface films, dipole moments, electron diffraction, x-ray diffraction, microwave spectroscopy, thermodynamic properties, dissociation constants, reaction kinetics, and the wave-mechanical theory.

World Economic Geography. By Earl B. Shaw, Professor of Worcester, Mass., State Teachers College. John Wiley & Sons, New York, 1955. Cloth, 6 × 9, 582 pages. $6.50.

Professor Shaw has applied special emphasis on the principles of economic geography to each chapter. Among the subjects covered are forest, fish, and animal industries, world agriculture, featuring climatic conditions, manufacture, trade, and population.

Process Engineering Economics. By Herbert E. Schweyer, Univ. of Florida. McGraw-Hill Book Co., New York, 1955. Cloth, 6 × 9, 410 pages. $7.50.

Another volume has been added to the excellent McGraw-Hill series in chemical engineering. It is both a text for students and a reference book for practicing engineers and other personnel in the process industries. Although it is aimed at the chemical, petroleum, mineral, chemurgical, and ceramics industries, it will be useful to all industries dealing with many processes. It explains the practical use of cost data in evaluating the commercial feasibility of processes, based on theoretical economic principles.

Among the major subjects covered are value of money, amortization, capital requirements of process plants, costs, earnings, profits and returns, replacements, economic balance, and the economic analysis of a complete process. The examples given enable an engineer to understand the principles involved.

Hawley's Technical Speller. Compiled by G. G. Hawley, Reinhold Publishing Corp., New York, 1955. Cloth, 5 × 7, 146 pages. $2.95.

At last there is a guide post for everyone who must write or copy reports dealing with technical subjects. It is significant that the authors are editors employed by a leading technical publishing house. It reflects years of frustration in handling manuscripts wherein authors have done their best in estimating how a complex word might be spelled. When such a word reaches the editor who must be sure about spelling before the word is cast in type, there is now a ready-reference manual that will show how words used in chemistry, engineering, metallurgy, electronics, medicine, and physics should be spelled. It is a book that should not be buried in a library but placed on the desk of the person who must type the final manuscript.

Technische Worterbucher Zellstoff und Papier, Part I, English-German, Darmstadt, Edward Roether Verlag, 1955. Fabricoid, 4 × 7, 223 pages. $6.

This Technical Dictionary for Pulp and Paper is useful in particular for finding out the German equivalent of English and should we say American terminology. It concerns itself with the converting industries and secondary fields such as rayon, printing, processing, and carton manufacture as well as the corresponding machine industry and pulp and paper as a whole. Part I does not convert German into English. The dictionary can be obtained in the U.S.A. from Stechert-Hafner, Inc., 31 East 10th St., New York 3, N. Y.

Problems and Control of Air Pollution. Edited by Frederick S. Malletti, A.S.M.E., New York, Reinhold Publishing Co., 1955. Cloth, 6 × 9, 272 pages. $7.50.

A record of the proceedings of the first inter-nation congress on air pollution held in March. Each chapter is written by an authority. Among the subjects are management aspects, biological problems, meteorological problems, health implications, standards of incinerator design, sulphur dioxide removal, and experience abroad.

Although the text does not point out a solution to kraft pulp mill odor problems, it shows how the general problem of air pollution is being attacked.

Microbiology, By Ernest A. Gray, chief bacteriologist, Biological Institute, England. Philosophical Library, New York, 1955. Cloth, 5 × 7, 175 pages. $3.75.

This book is intended to be an introduction to microbiology. It concerns itself with the biology of microorganisms, culture and control, bacteria, yeasts, molds, and fungi and applied microbiology and general water pollution.

Although this book was written in 1953, the American reprinting is current. It deals with a subject that is quite new and for many persons it supplies an elementary approach to chromatographics, absorption, partition, and ion-exchange and the treatment of colorless substance.

Note: Book reviewed in this column may be obtained from the Technical Association of the Pulp and Paper Industry, 155 E. 44th St., New York 17, N. Y.

A New Dry Process, Multi-Ply Board

JAMES D'A. CLARK

DURING the past decade considerable interest has been displayed all over the world in the manufacture of hard and medium hard structural boards from wood, especially residue wood that might otherwise be wasted. Several different processes have been developed or are under development, and the selection of one suitable for a given purpose usually involves making a series of choices in order to combine several different possible steps. This paper briefly discusses the main processes and more fully the new board process and mill just completed at Sandpoint, Idaho.

WET, MOIST, AND DRY PROCESSES

A primary decision is whether the process should be wet or moist or dry, and each his its advantages. Choosing a wet process restricts the choice of the raw material to fine fibrous flexible wood elements prepared by a semichemical or a wet mechanical pulping process, usually after reducing the wood to small pieces or chips. Its main advantage is the occurrence of some degree of papermaking bonding between the fibers at no added cost in return for the comparatively high expenditure for the heavy equipment needed to reduce the wood to a suitable pulp to form the slurry into a mat, and to press and dry the product. In some locations an important consideration is the supply and disposal of process water, which usually amounts to at least 3000 gal. per ton of board.

The choice of a moist, instead of a wet, felting process eliminates the cost of the cylinder or fourdrinier machine and associated liquid handling equipment and does away with the water supply and disposal problem. However, without the water, the natural bonding between the fibers, is also reduced. Also, not much relief is offered from the high cost of the preparatory equipment and power needed to make the fibrous elements which also should be flexible.

Going one step further, the choice of a dry process removes restrictions from the choice of the type of fibrous elements, and, especially if mechanically prepared fibrous elements are selected, a dry process has the advantage of requiring a substantially smaller plant investment per ton of product.

BOARD DENSITY

The type and shape of the woody element selected has a considerable influence as to where the optimum density of the resulting boards will be. Boards having a higher density have a much higher strength and are harder, but suffer the disadvantages of an increased raw material usage, for a given board thickness; have a greater tendency to warp, shrink and blister; and shipping and handling costs are higher. Because of this, increasing the density of boards to increase their strength and thereby reduce their demand for an expensive binder, is not a panacea. In general terms, it may be stated that with any dry process, the smaller and the finer the chosen woody elements may be, the higher becomes the optimum board density; alternatively, the greater is the resin usage to make a board having the same strength at a given density. As a result of this, and perhaps also with the extra cost of preparing dry flexible fibers, the coarser or inflexible types of woody elements or particles are preferred for most dry processes.

In a dry process, since practically no papermaking bonds can be developed between adjacent elements, the use of a binding agent is mandatory. Different types of woody elements require different proportions of binder to make a board having a given strength, and the cost of the binder, from about 10 to 35¢ per lb., even if used in small quantities, usually represents the greatest single cost of the board composition. Thus in choosing a dry process, both the kind of particle and the quantity of binder it requires, need to be considered together.

TYPES OF WOODY ELEMENTS FOR DRY PROCESSES

Besides the flexible elements prepared by a semichemical or semimechanical process, there are four other main types of particles which are used for the cores or bodies of synthetic wood boards, all of which are relatively inflexible. First, the finer heterogeneous waste particles derived from wood working plants, such as sawdust and planer shavings. Second short, coarse particles (in the order of $1/8$ to $1/4$ in. thick) produced by the mechanical reduction of small pieces of wood or wood waste as by means of a hog or hammermill. Third, long narrow particles derived from pieces of wood with a narrow cutting edge held perpendicular to the wood fibers and cutting between them along the grain. Fourth, either narrow or wide long flat particles cut from pieces of wood with a wide knife edge held parallel to the wood fibers and cutting between them across the grain. In the third and fourth types, combined or separate cutting edges are provided to define the width of the main cut. Wide, flat, intact particles, or "wafers," the fourth type, are believed to be the most desirable for the body or core of many boards, especially those having low to medium densities. These products are the subject of several pending patents. The use of narrow (thin) cross-cut elements particularly derived from the gentle disintegration of relatively thin cross-cut wafers, is described in the writer's joint U. S. pat, 2,689,092 assigned to others. Experiments have indicated that the finer material needs more resin for a given structural strength and is better suited to the manufacture of boards in the higher ranges of density.

Wafers

The first cross-cut wide particles, or wafers, experimented with, had vertical square-cut, ends. When these were mixed with resin and felted together it was found that, unless they were cut very thin, the effect of the abrupt ends was to introduce hair-line cracks in the body of the board and, when the board was broken as by bending, failure invariably started from one of these cracks. This effect limited the optimum thickness of wafers with abrupt ends to about 0.006 in. with Douglas-fir wood. Even so, boards made with 1-in. long wafers and having a density of 1.0, had a modulus of rupture of upwards of 6000 p.s.i. when mixed with as little as 5% of phenolic resin. Turner (*1*) later found that if the length of the wafers was extended to 3 in. with spruce wood, with 4% phenolic resin, the optimum wafer thickness then lay between 0.015 and 0.020 in. for boards having a density of 0.8.

After considerable experimentation, the happy thought occurred that instead of using wafers with blunt ends, they should be made with ends tapered to nothing in thickness. When a waferizer was developed to make wafers with tapered ends, 2-in. long wafers, about 0.030 in. thick mixed with only $1\frac{1}{2}\%$ of phenolic resin, yielded a board of a density of 0.75 which had a modulus of rupture of over 4000 p.s.i. (equivalent to over 8000 p.s.i. at a density of 1.0). As the wafers were made thicker and the same percentage of resin was used, the strength of the resulting boards went up, not down as happened with square-ended wafers, good results being obtained with taper-ended wafers as thick as $1/8$ in. with only $1/2\%$ of resin.

In order to minimize resin usage, the wafers should not only be as thick as possible consistent with the thickness and type of board made, but they should have smooth surfaces and be as wide and as long as possible. It was concluded and experimentally verified, that if the wood was not uncommonly hard, tapering the side edges of the wafers, along

JAMES D'A. CLARK, President, Sylvan Engineering Co., Inc., Longview, Wash.

the grain of the wood, added little to the strength of the resulting board.

Hardwoods have proved even better than softwoods (coniferous woods) for wafers, an effect that may be attributed to the difference in the kind of lignin present in hardwoods, which have three instead of two methoxyl groups attached to the aromatic ring of the basic lignin molecule. In consequence, hardwoods are usually the more malleable when heated. Exceptions are certain conifers like cedar and redwood, with which board strengths equivalent to that made with most hardwoods may be obtained with a saving of as much as one third of the small quantity of resin needed for ordinary coniferous woods. For example, with mahogany wafers 0.037 in. thick, about 3 in. long and with tapered ends, a board having a modulus of rupture of 8100 p.s.i. at a density of 0.6 was obtained (equivalent to a modulus of 13,500 p.s.i. at a density of 1.0) with 1.8% of phenolic resin. Boards made with other woods have had adequate strength (6000 p.s.i. modulus of rupture at 1.0 density) using as little as 0.5% of phenolic resin. Figure 1 shows piles of thick wafers for the core, the resin, and the thin face wafers that are put together, with wax size, for the piece of board in the background.

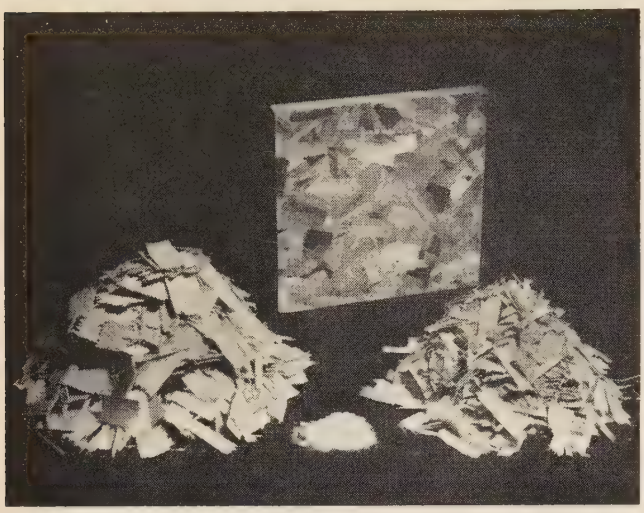

Fig. 1. The piles of thick wafers for the core, the resin, and the pile of thin wafers for the faces that with wax size, go to make the piece of board in the background

CLARK BOARD PROCESS

The following description applies particularly to the 4 by 16-ft. twelve-opening press "packaged" plant designed by the Sylvan Engineering Co., Inc., of Chicago, and presently being completed for the Pack River Lumber Co. of Sandpoint, Idaho, shown in Fig. 2. The design of the equipment, based on successful experience with a demonstration board plant which included a 4 by 4-ft. two-opening press and provided with automatic controls and handling throughout. A general view is given in Fig. 3. The new plant operates as follows:

Wood Preparation

Slabs and edgings from the saw mills are racked and so trucked to the board mill. There pieces bearing bark have it removed by passing them through a simple hydraulic machine recently developed by Sylvan Engineering Co. for that purpose. The debarker is operated by a small steam-driven pump and has a capacity of upwards of 60 tons per day of slabs and edgings. The new machine will also handle round wood split into two or more pieces which do not exceed 6 in. in width. Splitting round wood to give the pieces a flat face is advantageous in giving smoother cut wafers in the operation following. Bark is undesirable from the standpoint of the appearance of the finished board (unless it is confined to the core) and from the fact that with most wood species, bark wafers would constitute weak elements in the board structure. Dry or kiln dried pieces of wood may also be used if available, but are preferably moistened before being waferized. Selected pieces of wood to be transformed into wafers for the faces of the boards, are directed to their separate preparatory and storage system.

Waferizing

The large waferizer now installed which has a capacity of over 50 tons per day, was built by the E. D. Jones & Sons Co. of Pittsfield, Mass. It will handle pieces of wood of irregular cross section up to 6 by 6 in. and 4 ft. long. A smaller 2-ft. wide waferizer is used to transform the selected stock into face wafers. Several other types of waferizer are available with a feed mechanism adapted to the size and shape of the raw material to be waferized. If the wood pieces are in blocks of uniform width or length or thickness, they may be as short as 2 or 3 in. The waferizers work either by scoring the face of the wood with slant incisions, then shaving off the wafers like cutting veneer, or else, and preferably so, by using specially shaped knives to cut taper-ended wafers directly from the face of the wood. Because the wood is not cut across the grain, but between the fibers, the power requirements for making wafers are exceedingly low—less than 1 hp.-day per ton—for wafers of normal thickness. The high-speed steel knives may be sharpened while in position on the machine in a few minutes.

Sawdust, Sliver, and Knot Separation

After being cut, the material from the waferizer passes over a 4 or 5-mesh screen to remove any fine material such as dirt, bark particles, and sawdust. The material is then winnowed to remove any slivers or unsliced knots or small chunks of wood that may be present. With the knives and bed plate of the waferizer properly adjusted, and with fairly uniform pieces of wood, there should be no more than about 3% of the wood substance lost as fines and 3% as slivers. Usually the wafers to form the faces of the boards, are cut thinner so as to give the boards a smoother surface, and one which does not need to be sanded for most uses.

Storing and Metering

The wafers for the core, and the two facings of the boards are stored separately in large, deep annular chests of special design, holding half-a-day's or more supply. The material is added to the chests continuously and circumferentially, and a truly representative supply is removed from a radial, vertical section of each chest. This procedure serves to eliminate any abrupt variations in wood species, moisture, or other changes and constitutes a very great advantage for the new process, previously held only by a well-designed, wet process plant with a large storage capacity. The streams of wafers are metered from each chest at the fixed rate desired and uniform layers pass through a couple of multiple channel continuous driers. These are provided with control mechanisms which maintain the moisture in the wafers at a fixed percentage in the range desired, about 10 to 15% for the core and 20 to 30% for the facings.

Wax or wax size and the desired percentage of powdered resin is metered to the streams of wafers, which are passed through separate continuous mixers. After gentle but thorough mixing, the streams, which may be split if desired, flow continuously to their respective felters. By turning a switch on the main control panel located at the press, and observing a speed indicator the press man can immediately and precisely increase or decrease the rate of flow of any stream or all the streams of material together without altering their composition. The latter is accomplished by mechani-

cally interlocking the drives for the meters, driers, and mixers so that the speed of all may be adjusted upwards or downwards as a collective unit, to suit the desired pressing cycle for the board being made.

Felting

Felting is one of the most important steps in any board process since the uniformity of the density, the thickness, and the appearance of the product is determined thereby, espe-

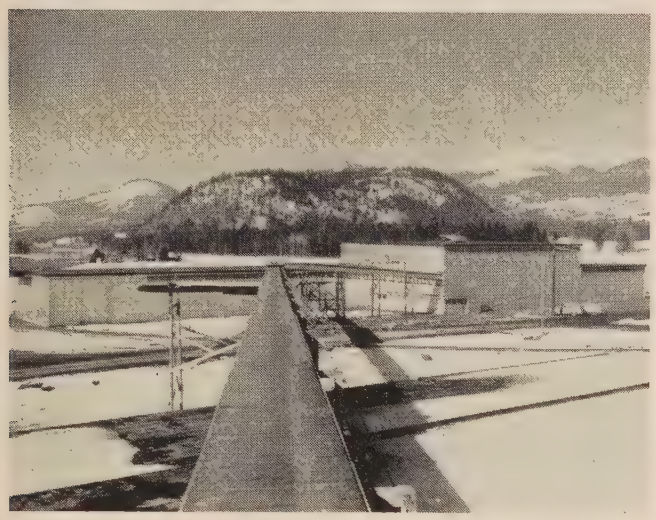

Fig. 2. New Clark process board plant for Pack River Lumber Co. at Sandpoint, Idaho

cially if, as in the new process, the uniformity of thickness of the boards is obtained by uniform felting rather than by subsequent sanding. A radically new felter has been developed with no orifices to plug, very gentle in handling the wafers, and one which gives a constant, uniform mat once it is adjusted and locked in position. A weight variation of less than 2% with 6 by 6-in. samples across the width of the board is normally achieved with a careful adjustment.

Provision is made for five felting heads in series, so as to be able to form a multilayer board. The different layers of wafers and ingredients are felted into a mat of fixed width onto a continuous succession of cauls or press plates, moving along end to end beneath the felters at a constant but adjustable speed. This speed adjustment is also under the handy control of the press man who may either change the speed of the cauls, the rate of feed to the felters, or both so as to increase or decrease the weight of the board if he wishes this to be changed, or to regulate the production of the felters in accordance with the output of the press.

Mat Handling

In order to separate the continuously felted wafers into a series of individual mats centered on the cauls, an automatic area-control for the web has been developed. This mechanism gives a mat with vertical ends which, when wafers are used, has a particularly firm "dry brick" construction. If desired, the same mechanism can be adapted to the felting of variously shaped fibrous mats such as hollow squares that might be desired for frames. The unwanted areas of the deposit are indirectly returned to the felters so that there is no waste.

As the cauls bearing the completed mats proceed forward, the leader is speeded up to a station where a top caul is automatically and gently placed over it. The sandwich so formed then moves into an elevator, and is delivered into the next one of a number of openings in a vertical storage rack, corresponding to the number of openings in the press. When the rack is full, an automatic mechanism moves the whole charge forward into another rack, which then is automatically moved sideways into the charging position ahead of the press.

Pressing

The multiopening press employed may be conventional, but for this process, in order to reduce the capital cost of the plant substantially with an improved performance, it is of radically new design, being made with a rectangular piston of the same size and shape as the boards. Its practicability has been proved by continual trouble-free operation for nearly 3 years of the 4-ft. square, piston press which was designed for 750 p.s.i. The size and rectangular shape of the piston in the new 12-opening press (4 by 16 ft.) ensures that (1) the pressure is applied uniformly all over the area of the board, (2) the uniformity of this pressure will not be disturbed by structural or temperature strains, (3) the pressure of the hydraulic actuating fluid (in this case water with suitable antirust and lubricating agents added) is little more than the pressure applied to the board (a maximum of 480 p.s.i. in this instance, which considerably reduces the cost of the pumps, piping, and control valves) and (4) almost every pound of steel in the press, bears its full working load (mostly in tension) when the press is in operation. As a result, the weight of the press has been considerably reduced over that of a conventional press; also it requires no special foundations except to accommodate the discharge and accumulator tanks beneath it. The press is made throughout of welded steel plate, and, except for the faces of the platens and the skirt of the piston, no other major machining operations are necessary, despite its ability to produce boards of precise and uniform thickness. Consequently, and with its light weight, the cost of the new press is very considerably less than that for a conventional one The new large 12-opening press was built by the A. O. Smith Corp. of Milwaukee, Wis., to Sylvan Engineering Co.'s design.

Simple charging and discharging mechanism has been developed with a new improvement so that when the press automatically opens at the conclusion of each pressing cycle, the cauls with their pressed boards are individually pulled, not pushed, out as a set and simultaneously the awaiting mats and cauls are smoothly pushed into their places. The new design of charging and discharging mechanism ensures that no warping or sticking of a caul plate on the platens will cause an interference. After the press is charged, it is automatically and quickly closed by water supplied from a low-pressure, air actuated, accumulator tank. When fully closed, a preselected high pressure is applied from a high-pressure air-actuated accumulator. Thereafter, a specially developed automatic control micrometer takes over and adjusts the pressure downwards, so that at the end of each pressing cycle, the boards are exactly at their desired thickness. If it is wished to change the board thickness, that of the next batch of boards will change in response to an adjustment made to the calibrated micrometer. The escape of generated steam and gasses while the board is under pressure is greatly facilitated by the size and shape of the wafers.

Caul Separating and Handling

After the 12 boards and their cauls have been discharged from the press, they are automatically lowered and individually discharged into a specially developed caul and board separator. Each sandwich is separated in sequence, and forceably if need be, which should be seldom. The cauls are discharged sideways to the caul return line, the top caul being turned over so that its smooth working face is up and they are conveyed, through a storage mechanism, back to the felter section.

Board Treatment

As the boards issue from the caul separator, they are automatically weighed, have their side edges rough-trimmed, are

lightly brushed to remove any loose particles, and are delivered to a conveyor table. When this is complete with each batch of boards, the table moves the pile into and inserts it under a high pile of previously made boards in a hot stacker of new design, where they are maintained under pressure for several hours at a selected high temperature. This heat treatment under gradually reducing pressure, completes the cure of the resin binder, removes any strains in

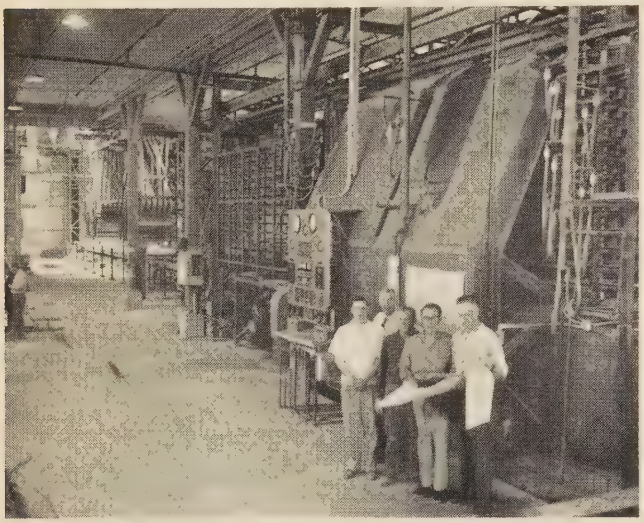

Fig. 3. View (L. to R.) of the face chests, felters, press loading mechanism, central control panel for the entire process, and the 4 ft. 6 in. by 16 ft. 6 in. rectangular piston press for Clark process board. In the foreground are the men who conceived, designed, and built the new plant: Fred Owen, James d'A. Clark, Charles Nettlingham, Russell Reed, and Robert D. Lambert

the board that might be imparted during the pressing operation, and improves their water resistance.

As each hot board is cured, it passes to a humidifying or conditioning tunnel in which the board is suspended vertically from one of its long edges and close to the previous board, but with an air space between. During the several hours in the tunnel, the boards assume their normal moisture content, about 6%, and are cooled.

As each board enters the tunnel, one conditioned board drops out and is fed to a radically new automatic trim saw especially developed for this purpose. The new equipment firmly holds the board on a moving table by suction, while it trims off the edges and cuts the board into smaller sizes if desired. The design of the new saw is such that individual boards are consistently sawed, trimmed, and squared to within $^1/_{64}$ in.

After they are trimmed, the cut boards are automatically delivered onto skids or tables for marking, wrapping, and shipment.

CLARK PROCESS BOARD UNIT

It will be observed, that with the fully automatic operation of the multiopening press and its associated equipment, charging and discharging and caul separating mechanism; the felted mats and cauls enter as a continuous stream, are pressed in batches, but leave as a continuous stream of pressed boards. Accordingly the arrangement just described is equivalent to a continuous press operation for making structural boards, provided that the continuous press was nearly 200 ft. long in order to be capable of the same rate of production, since this rate is governed primarily by the extent of the surfaces available for heat transfer.

With the new unit, boards of almost any thickness may be made directly, from about $^1/_{16}$ in. upwards, but, because the press time increases with about the square of the thickness of the boards, boards thicker than about $^3/_8$ in. are best made by laminating two or more thinner boards together. This operation may be expeditiously accomplished by a rapid secondary process developed for this purpose. The maximum tonnage of boards is obtained when the thickness of the boards is between $^3/_{16}$ and $^5/_{16}$ in. With average woods, a board density of between 0.65 and 0.75 is preferred, but this range may be extended if desired.

In addition to using different woody materials in the core and faces, various and different amounts of resin or other, binders may be used with the different facings or laminates to produce a wide variety of boards suitable for most interior uses, and if the percentages of resin are increased, for exterior uses too. For decorative or other purposes, a facing of pure resin or plastic film, or a layer of granular or fibrous material may be consolidated with a face of the board during the initial pressing operation. The boards may be covered subsequently with wood veneer or with paper, textile, or metal sheets by the secondary laminating operation already referred to, if not added during the initial pressing operation. These possible variations in construction, combined with the use of wafers of different sizes and thicknesses in any lamina, make the new process perhaps the most versatile so far devised.

The cost of a "packaged" unit, comprising a 4 by 16-ft. 12-opening press and associated manufacturing equipment together with a suitable building is less than, or is in the neighborhood of $750,000 depending on local conditions and the type of building desired. Such a unit will produce upwards of 70 tons per three-shift working day, of $^1/_4$-in. thick, double-faced boards, equivalent to over 160,000 sq. ft., or about 60 tons of $^5/_{16}$-in. thick boards, and more will be produced if the boards are not double faced, since the facings introduce extra moisture into the press and so increase the time cycle. Enough particulars of the new process have been described to enable those familiar with manufacturing, to estimate the probable cost of the product, which, it will be found, is relatively low, because of the low resin usage.

BOARD PROPERTIES

Because the wafers lie flat in the plane of the board, are oriented in all directions, and are well bonded together, the coefficient of expansion of the boards in length and width with changes of temperature and humidity, is very small, being about the same as wood in the direction of its grain. In some cases, their contraction and expansion is less than one-quarter that of boards made from coarse or chunky wood particles. This makes the new boards of especial value where a maximum of lateral stability is important, as for ceiling, wall, or floor coverings.

For general interior use, an excellent board may be made from the usual coniferous woods with less than 7% of phenolic resin in the faces and less than $1^1/_2$% in the core, equivalent to an average resin content of less than 3% for the entire board. Such a board would have a modulus of rupture of about 4000 p.s.i. at a density of 0.7 (equivalent to 8000 p.s.i. at a density of 1.0) and with 3% of wax size, a 24-hr. water absorbency test of less than 20% from 50% R.H. at the 0.7 density.

With uniformity with which the boards are felted and pressed, they issue from the press with smooth surfaces, ready for use without first having to level the surfaces to a uniform thickness by sanding. The sanding operation is not only somewhat costly, but it partially destroys the interesting wood grain effect of otherwise intact wafer surfaces and removes the thin protective outer resin film. However, the removal of this film may be an advantage if the boards are to be subsequently glued or painted.

Unfaced core boards (which require less time in the press than when faced) preferably after sanding, are suited for use as furniture core stock. With their uniform density, they do not readily telegraph a pattern through to the veneer. Core

boards with a modulus of rupture of about 300 p.s.i. at a density of 0.65 (equivalent to 7000 at a density of 1.0) may be made from coniferous wood with less than $1^1/_2\%$ of phenolic resin. With cedar or a deciduous wood, less than 1% of the resin may be sufficient.

Because of the small proportion of resin used and the consequent "woody" character of the boards, they do not quickly dull the edges of sharp cutting tools, often an adverse factor

Fig. 4 Specimen of Clark board showing its machinability

with boards having a higher resin content. The wood-working and other properties of the new boards are very similar to those of plywood, in fact the new board is a "multiply" board with most of plywood's properties, such as good screw and nail holding power perpendicular to the faces. In addition, thick laminated boards may be satisfactorily turned in a lathe to make such items as lamp bases or furniture legs. Since the cores are composed of wafers which are in effect actually pieces of thin veneer, the new boards give strong tongue-and-grooves and hard wearing edges. Samples of the new boards appear to be well liked by both amateur and professional carpenters and cabinet makers, not only for their wood-working qualities, but for their intrinsic beauty. A specimen of machined board is shown in Fig. 4.

With the versatility of the process and the endless number of combinations of materials possible, conditions of manufacture can be chosen to make a board suitable for almost any given job.

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Note: Wafers with wide faces and particularly those with tapered or otherwise thinned ends, form the basis of the Clark board process. Boards made with wafers throughout, or for the core, are covered by a series of patent applications in the United States and Canada and by other applications in leading foreign countries. A recent issue is Brit. pat. 730,017 of May 18, 1955. These applications are assigned to the Changewood Corp., Suite 1160, 209 S. La Salle St., Chicago 4, Ill., which holds also the patent rights to the new process steps and new machinery described above.

The Detection of Silicate Fillers in Paper

W. H. HOGE and D. R. MacKINNON

THE increasing use of silicate fillers in paper has developed a need for a satisfactory method of detecting these materials in the presence of other pigments. The problem of determining silicate fillers has been complicated by the fact that paper samples which contain calcium silicate might also contain both calcium and silica from other sources. This paper describes a quick analytical test developed in the Oxford laboratories which appears to be satisfactory for the qualitative detection of calcium silicate and precipitated silica pigment under most conditions.

The procedure is based on the observation that silicates of calcium, magnesium, and sodium yield a quantity of soluble silica upon treatment with dilute acid. The soluble silica is detected by the deep yellow color formed by the addition of ammonium molybdate. Silica from various types of filler clays causes little or no interference under proper conditions of acid treatment.

The test is easy to apply. A paper sample of about 0.1 gram is placed in a test tube with 15 ml. of 0.1 *N* HCl and 1 ml. of 10% $(NH_4)_2MoO_4$. The test tube is then heated in a boiling water bath for 45 min. At the end of the heating period, the mixture is treated with 1 or 2 drops of 5% $NaIO_4$ solution to prevent the interference of molybdenum blue. The mixture is then cooled and treated with 2 ml. of 5% oxalic or citric acid to eliminate phosphorus interference. A yellow color indicates the presence of a silicate-type filler.

This procedure has been tested on a variety of commercial papers and handsheets which contained known filler mixtures. In some cases a light tan color was formed which would complicate the detection of very small amounts of soluble silica. However, all the commercial and laboratory sheets which contained over about 1% $CaSiO_3$ gave definite positive tests. Similarly, the sheets without calcium silicate or precipitated silica failed to give the definite yellow color. The procedure successfully showed the presence of 1% $CaSiO_3$ in a sheet which also contained 20% filler clay.

A yellow color might be formed by certain interfering materials. Arsenates and phosphates form a yellow color with the molybdate, although oxalic or citric acid can be used to prevent interference due to phosphate. The test will also be affected by the presence of other soluble silicates such as those which might originate from sodium silicate in a peroxide bleaching operation.

Different types of silicate filler respond differently to this test. The finely ground, dry commercial calcium silicate and the precipitated silica pigments do not give as deep a yellow color as an equal concentration of filler which had been precipitated on the fibers by the addition of sodium silicate and calcium chloride to the beaters. This difference, which is probably due to the acid solubility, is one of the major obstacles in the development of a quantitative procedure.

The outlined procedure is only satisfactory for qualitative detection of silicate fillers. Arsenic would probably interfer but most papers contain very little or none of these compounds. Interferences due to clay and possibly other fillers might tend to cause inconclusive results if the sample sheet contains very small amounts of calcium silicate. However, most commercial sheets with calcium silicate fillers will probably contain over 1% of this material and positive results could then be expected.

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Forty-First Annual Meeting, Commodore Hotel, New York, N. Y., February 20–23, 1956.

Seventh Coating Conference, Benjamin Franklin Hotel, Philadelphia, Pa., May 7–9, 1956.

Eleventh Engineering Conference, Sheraton Plaza Hotel, Boston, Mass , October 8–11, 1956.

Sixth Corrugated Containers Conference, Statler Hotel, St. Louis, Mo., October 17–18, 1956.

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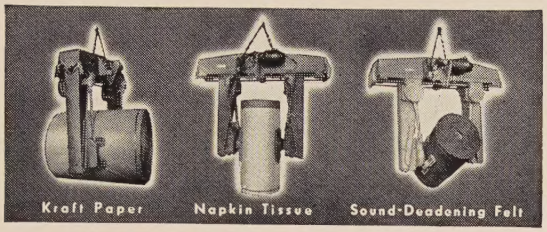
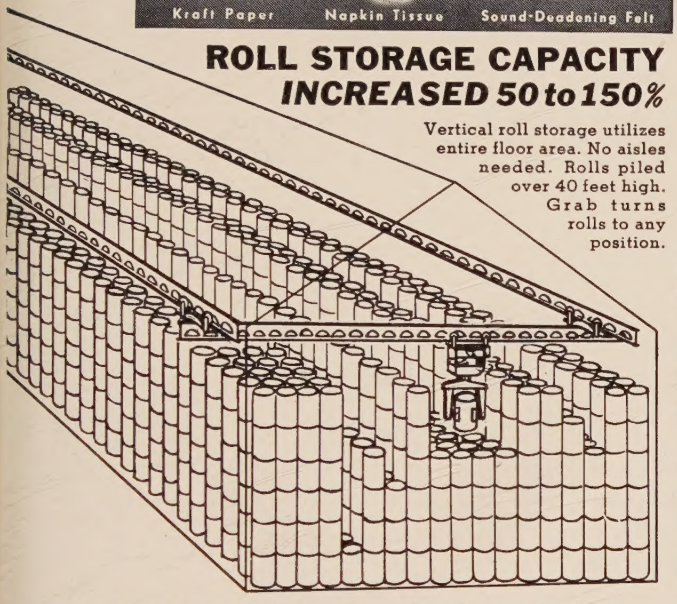


HANDLING IN THE PAPER INDUSTRY

● Many paper mills and paper products plants are enjoying numerous advantages possible with Cleveland Tramrail. They are speeding production and lowering costs by eliminating rehandling. They are reducing floor congestion and removing hindrances and confusion. They are aiding safety. They are using overhead space to save floor space. They are reducing spoilage and greatly increasing warehouse capacity by eliminating need of aisles and piling higher.

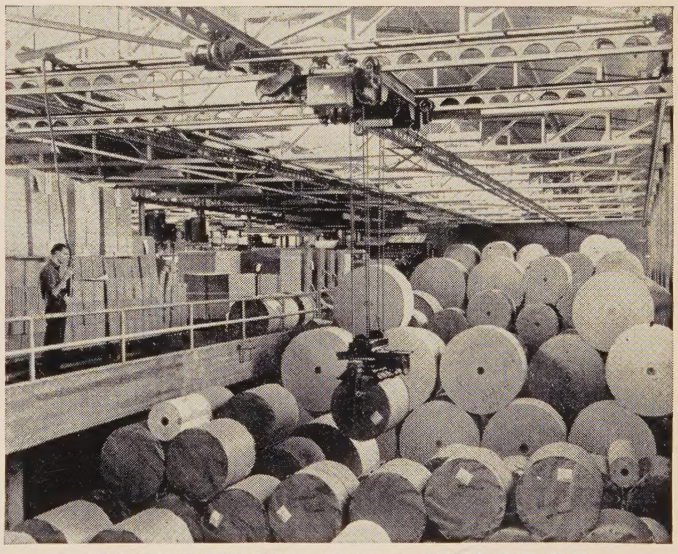
ROLL STORAGE CAPACITY *INCREASED 50 to 150%*

Vertical roll storage utilizes entire floor area. No aisles needed. Rolls piled over 40 feet high. Grab turns rolls to any position.



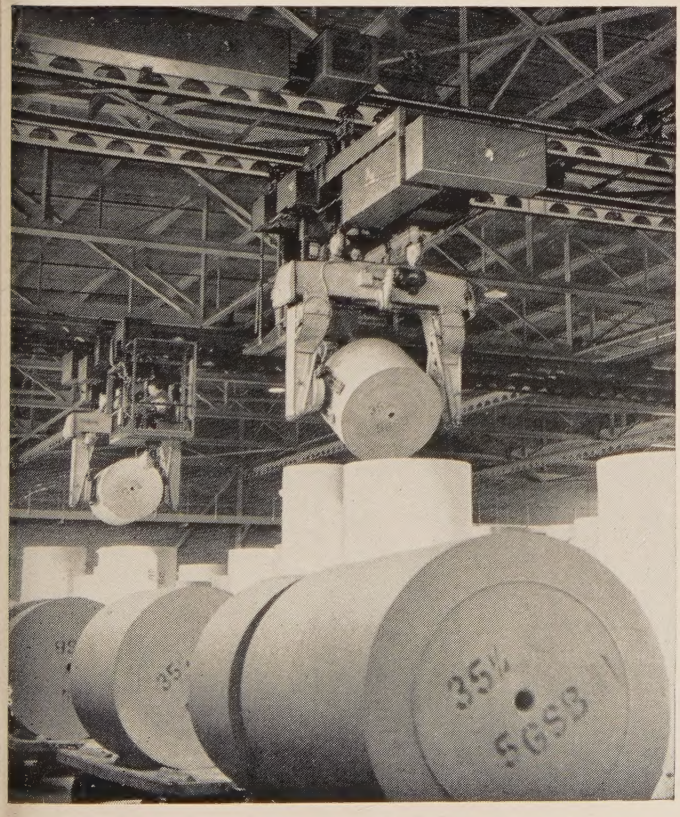
VERTICAL ROLL STORAGE

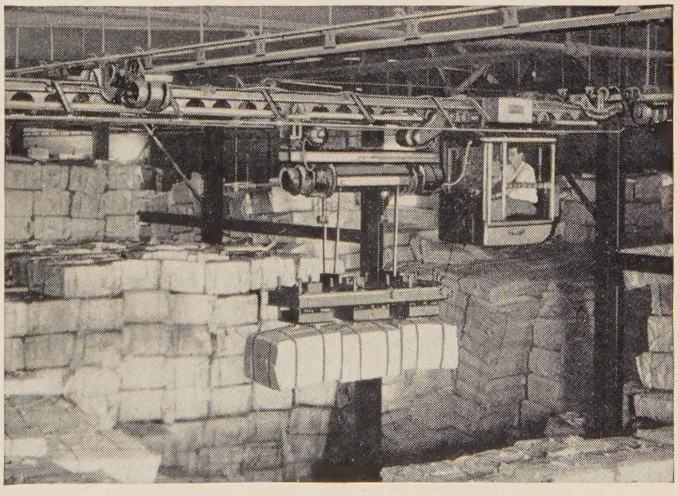
From 50 to 150% more rolls can be stored in a building when served by a Cleveland Tramrail crane and motor-driven roll grab. One man can usually take care of entire storage and handling job from the crane cab. Paper spoilage often reduced as much as 1% of all handled.



HORIZONTAL ROLL STORAGE

One operator with this floor-operated Tramrail crane and motorized grab can handle all rolls in and out of storage without assistants. This cuts man-hours of handling time. Roll damage due to crushed edges, cuts, tears, is also reduced. Storage capacity is increased.





SCREW-GRAB PULP HANDLING

200 tons of pulp are easily handled in an 8-hour day with a Tramrail crane and screw grab. Screws worked into the pulp hold heavy bales solidly. This method saves time and increases pounds stored per square foot because aisleways are not necessary. Safety is improved.

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2

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